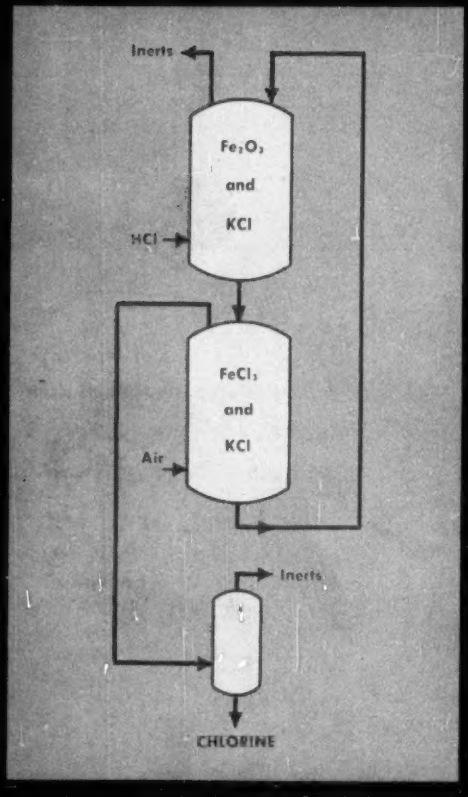
MAY
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Chemical Engineering



+ Nine more processes to make Chlorine without caustic

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What cathodic protection can accomplish in your plant

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Operating secrets from a coal hydrogenation plant

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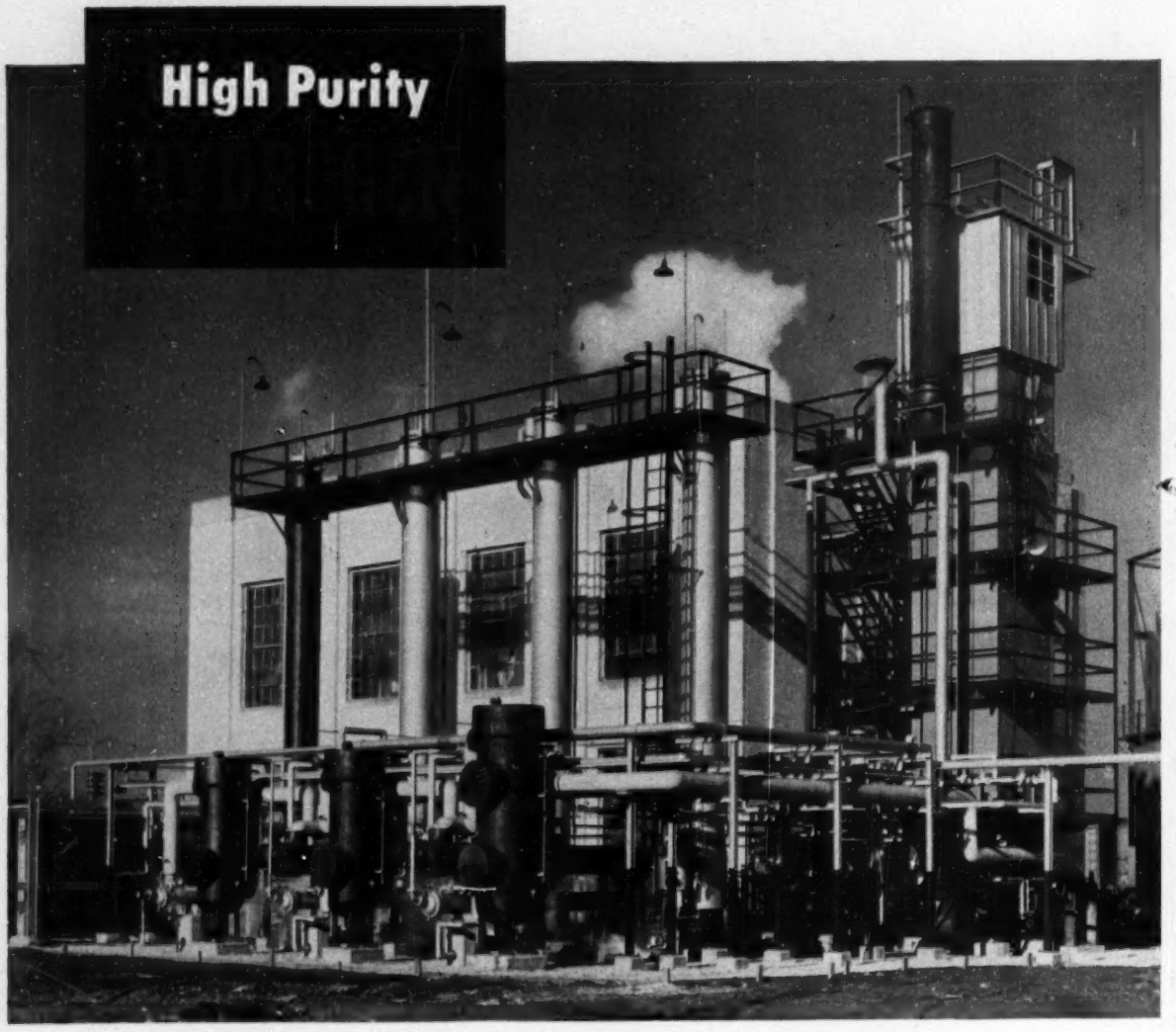
Lifesaving tips on the best approved safety practices

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How you can make estimates on costs of heat exchangers

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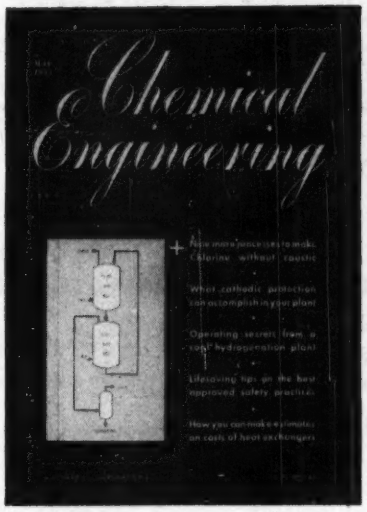
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GUIDED TOUR

JOHN R. CALLAHAM, EDITOR



. . . Today's need, tomorrow's trend, point toward chlorine-sans-caustic.

Already solid development work is under way. And by 1960 at least 200,000 tons of chlorine yearly may well be made by processes that produce no caustic soda.

Looking ahead, Author Gordon points out those methods most likely to succeed. He examines their technology, spells out their impact in this first published survey of the field *(Feature Article)*.

Fluidized solids now comes of age.

As a new unit operation, the fluidized solids technique has much to offer chemical processors. Author Sittig here gives a timely survey of fluidization know-how and process applications *(Feature Report)*.

Want to know what's happening?

Why Kidde now sees the green light for atomic power reactors? Or how Kaiser uses sink-float to upgrade dolomite?

Or why a new German coal gasifier uses

Please turn page

What's Coming Up

Our next issue will be a special one on Heat Technology. It will have a dozen or more articles on the production, containment, transport and transfer of heat and cold.

In later months we'll continue, of course, Gilmour's popular series on shortcuts to heat exchanger design as well as Rubin's new series on heat exchanger costs. Another article will deal with the design of cooling ponds.

Then there'll be a practical article on how to pick corrosion resistant materials. Another will tell how the small company can set up its own corrosion test program.

Packed towers will call for two engineering articles. Developments in plastics process equipment will soon be the subject of a special report.

The ever-popular subject of costs and cost estimating will be represented by articles covering the economics of chemical packaging, power plant costs, the elements of plant cost, dust collector costs and the economic aspects of inventories.

GUIDED TOUR

the pulse-jet or buzz bomb principle and is pulling wide attention?

How SRRL's filtration-extraction process gives more and better oils — or how Bamag's use of the explosive action of steam under vacuum upgrades fish oil?

Or how Union Oil's Hyperflow gas-lift method elevates dense solids? *(What's Happening . . .)*.

How you can use cathodic protection.

Now you can use this pioneer technique right in your own plant to cut down corrosion of tanks, heat exchangers, clarifiers and other equipment. Author Sudrabin tells how *(Feature Article)*.

New data on heat exchanger costs.

Here Author Rubin gives up-to-date unit costs, physical data, factors that influence selection—everything you need for a sound evaluation *(Feature Article)*.

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WHAT'S HAPPENING IN CHEMICAL ENGINEERING

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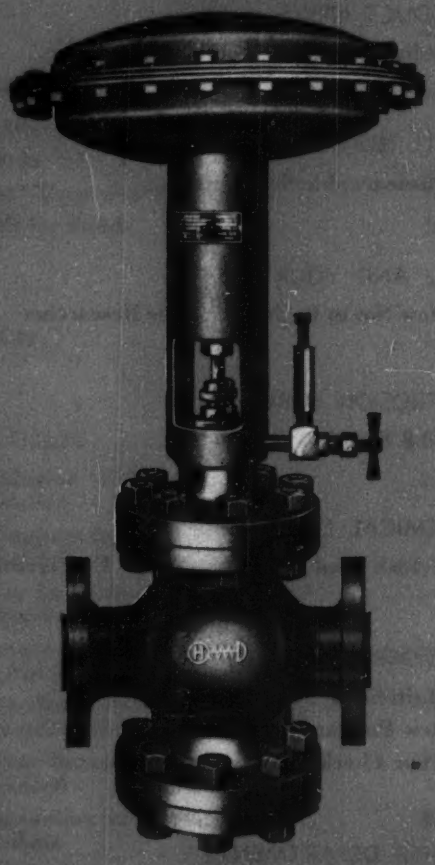
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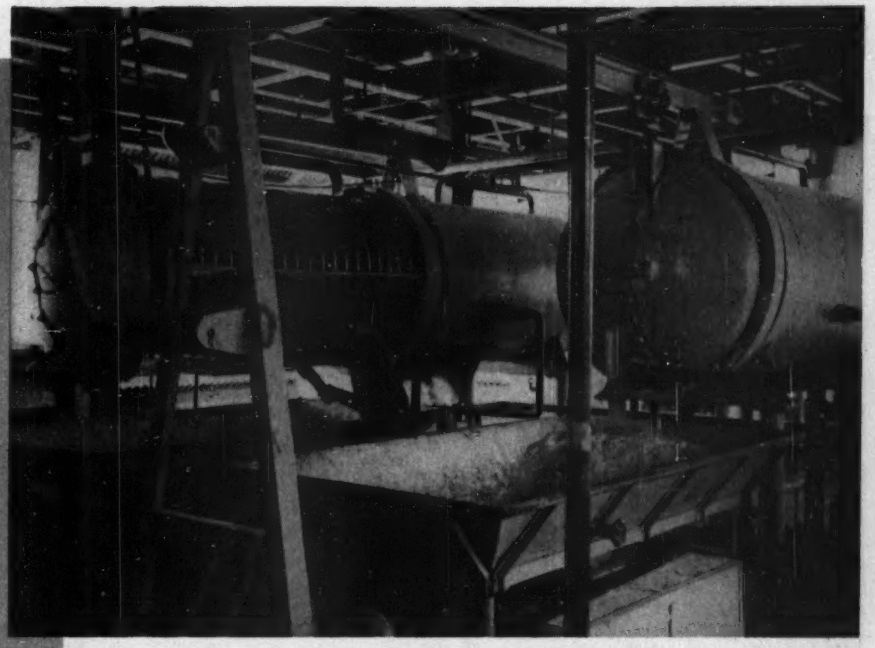
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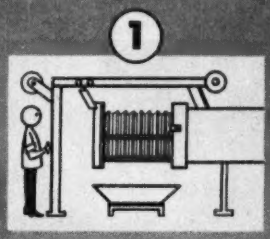
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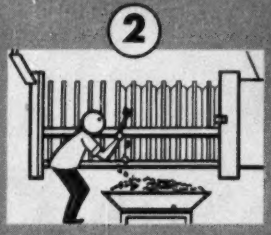
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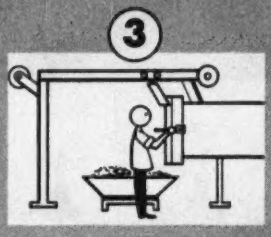




One motion unlocks the quick-opening filter cover. The all-metal leaves roll out of the filter as a unit.



Operator taps leaves to drop cake into trough, hopper or wagon for recovery or disposal.



Then he returns clean leaves into filter. The cover locks pressure-tight with one swift motion.

Large-capacity filter

is easy to clean between cycles

One man can open this filter, dump the cake from it, and close it again—in about ten minutes!

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Niagara can now offer you both vertical and horizontal pressure-leaf filters, with unit sizes from 20 to 1500 square feet. If you are a big user of filtration, you'll want all the facts on what these filters can do for you. Just write or mail the coupon today.

LARGE CAPACITY—The Style "H" Filter delivers high-clarity filtrate at rates up to 45,000 GPH. Sizes range up to 1500 sq. ft. of working filter area in one compact, leak-proof unit.

ALLOY CONSTRUCTION—AT LOWER COST—Because of its simple fabricated design, you can have the Niagara Filter in stainless steel and other alloys, for corrosion resistance, at low cost. Special linings are available, too.

EXCELLENT CAKE-WASHING CHARACTERISTICS—Almost true displacement washing.

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(When writing, please use above address)
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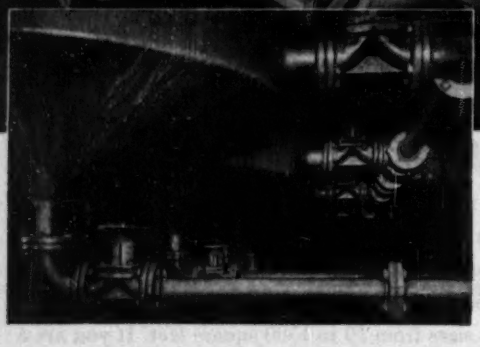
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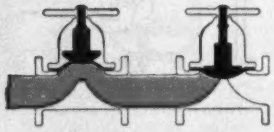
"Most troublesome part of Sewage Treatment..."

is the final disposal of sludge", says W. E. White, Chief Design Engineer, Dept. of Public Works, Houston, Texas. Shown here in the Houston sludge disposal plant are two chain-wheel operated, 10-inch, rubber lined Grinnell-Saunders Valves, with neoprene diaphragms, handling filtrate from vacuum filters with a PH of 3.5 to 4. This filtrate is a 2% to 3% solution of Ferric Chloride on a 15" to 20" vacuum. Temperature is atmospheric.





◀ In same plant. Eight 3-inch rubber lined Grinnell-Saunders Diaphragm Valves, handling 8% to 10% Ferric Chloride, at atmospheric temperature



A job well-suited to GRINNELL-SAUNDERS DIAPHRAGM VALVES

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Working parts absolutely isolated from fluid. Diaphragm completely seals off working parts from fluid in the line. No sticking, clogging or corroding of working parts. Valve lubricant cannot contaminate fluids.

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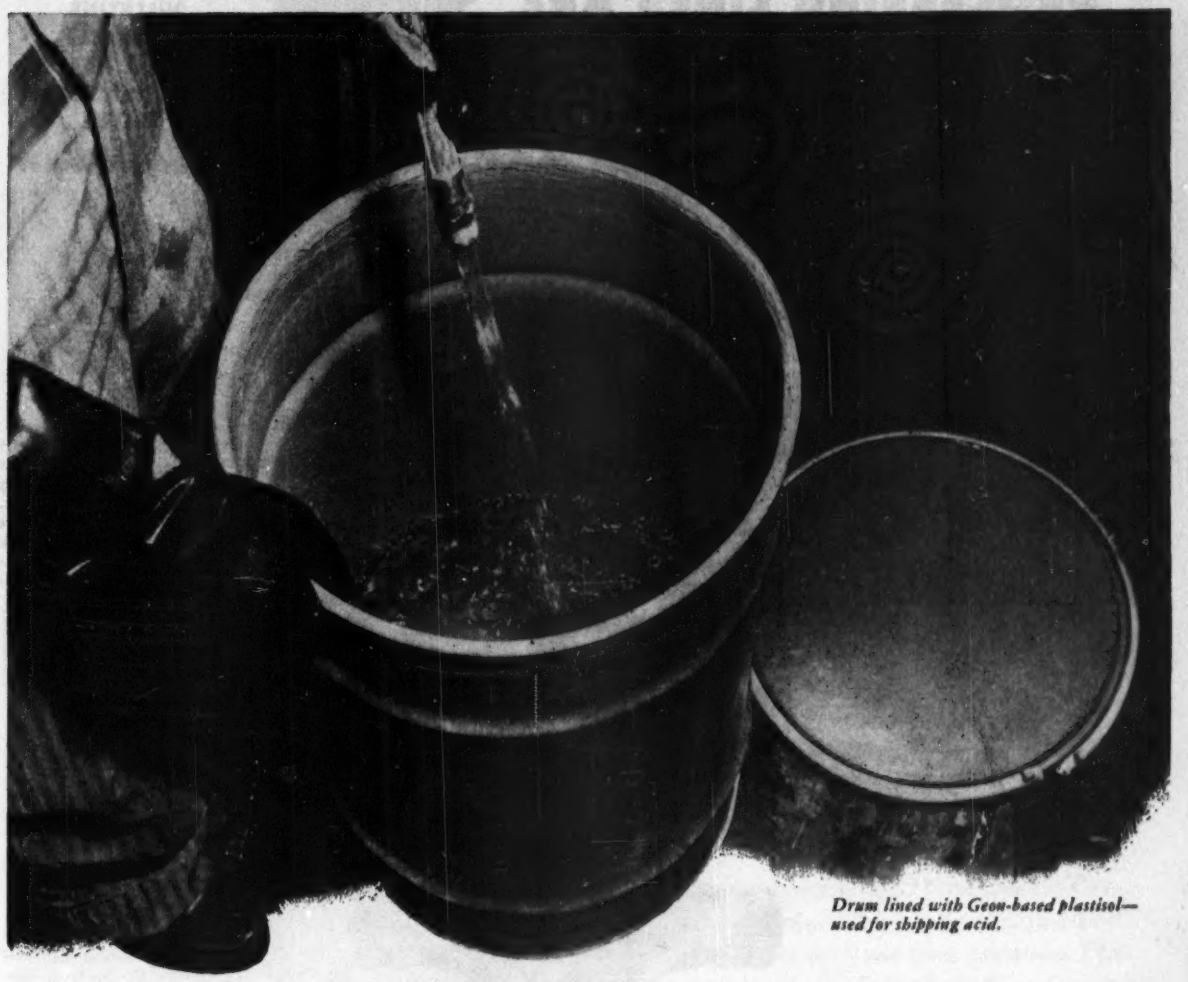
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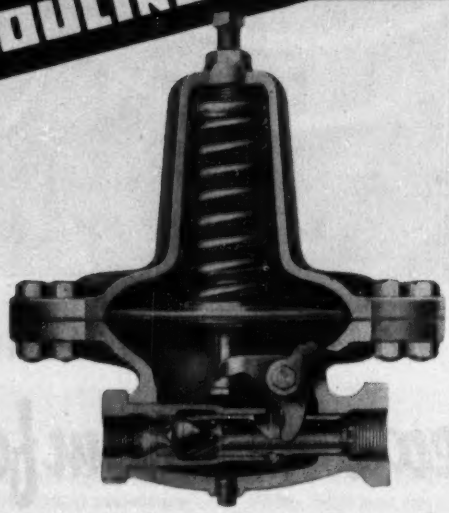


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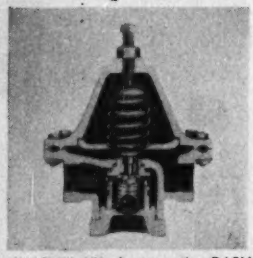
When you put this Streamlined construction on your lines you have no complicated parts to get out of order, no small ports or passages to clog up. There are no close fits. It's straight line flow all the way — flow that gives you maximum capacity, close delivery pressure control, and tight closures — flow that saves you money all along the line — flow that means elimination of failures — speedier production and no spoilage.

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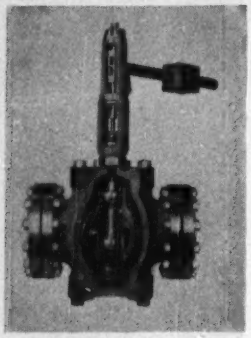
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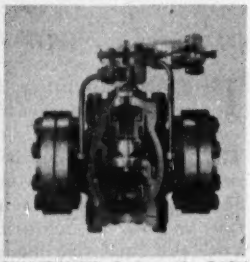
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BULLETIN 950—features the CASH STANDARD Type D Single Seat pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



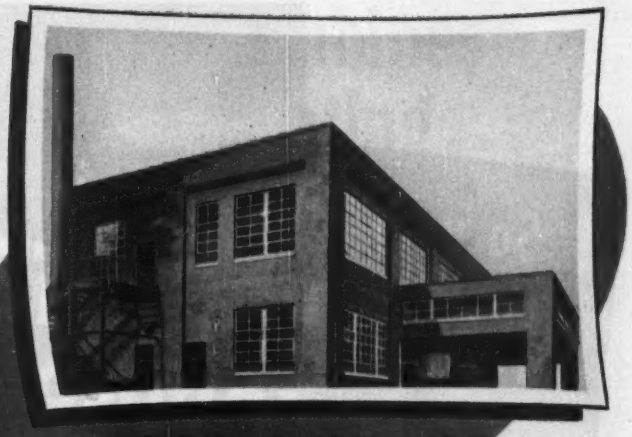
BULLETIN 965—features the CASH STANDARD "42" Series—a complete line of balanced lever valves for handling almost anything that will flow through a pipe except some injurious chemicals. Two full pages show 16 installations with descriptions.



BULLETIN 967—features the CASH STANDARD Tye II Condenser Water Regulator — self-contained — pilot-operated for controlling the flow of cooling water to condenser coils. Used with water or air —with any gas or oil that is non-corrosive—and with all refrigerating fluids. Blueprints show installation at outlet of condenser and at inlet. Capacity charts are shown.

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BIRD MACHINE COMPANY

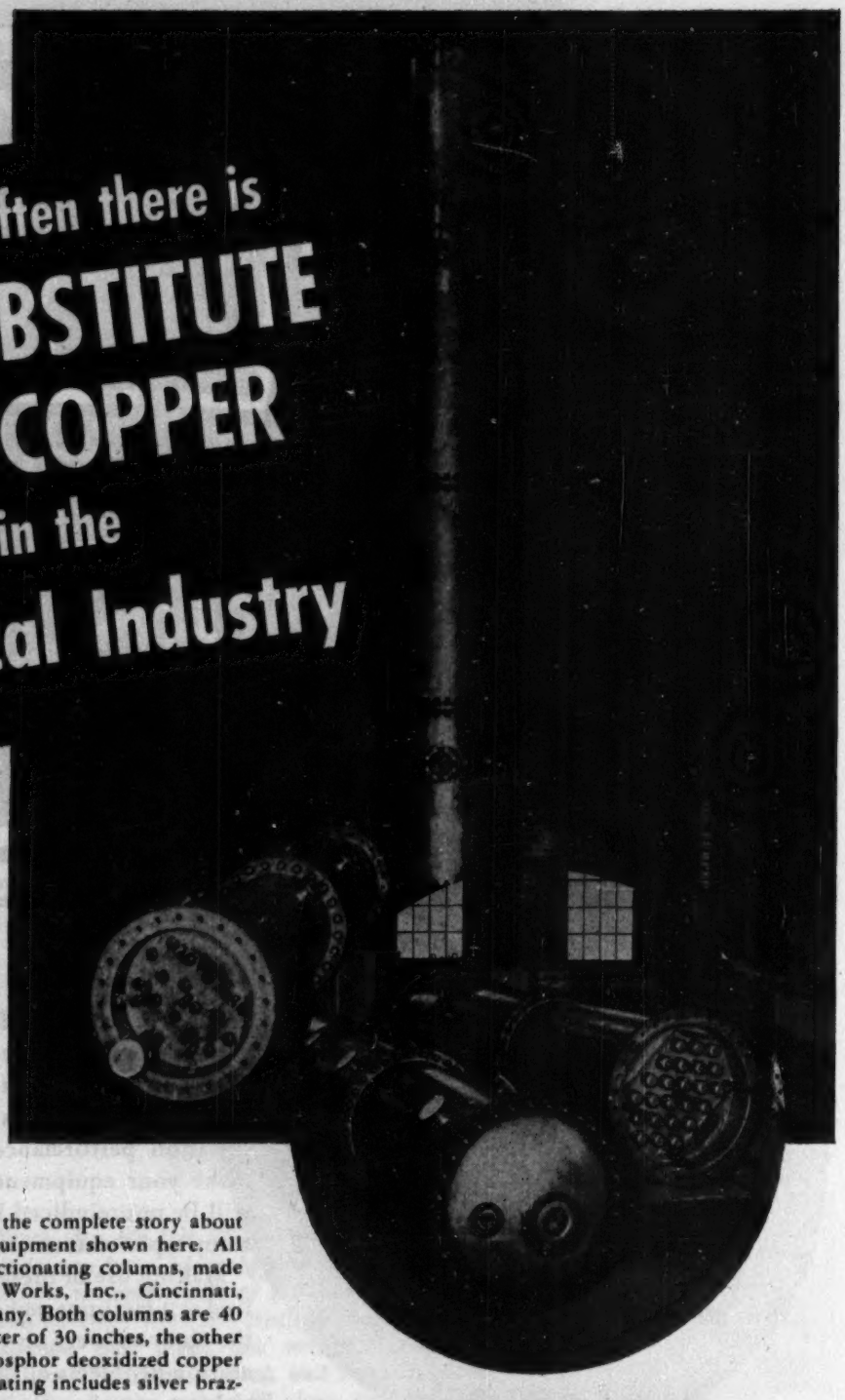
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NO SUBSTITUTE FOR COPPER

in the

Chemical Industry



Fractionating columns made by Ansonia Copper & Iron Works, Cincinnati, Ohio, for a prominent chemical company. Ansonia was established in 1896, and has always been a customer of Revere—good companies like to do business with each other!

● We wish we could tell you the complete story about the two pieces of chemical equipment shown here. All we can say is that they are fractionating columns, made by Ansonia Copper & Iron Works, Inc., Cincinnati, Ohio, for a well-known company. Both columns are 40 feet high, and one has a diameter of 30 inches, the other 24 inches. Revere supplied phosphor deoxidized copper plates, and copper pipe. Fabricating includes silver brazing with compressed natural gas.

You will find a lot of copper, various types of Revere Copper, in chemical plants. The metal has many advantages, including the highest heat transfer of any commercial metal, complete lack of reaction to many chemical fluids and gases, long life, the high electrical conductivity that is sometimes important, and surprisingly easy fabrication by stamping, bending, soldering, welding, brazing. If you are fabricating or ordering chemical equipment, look into Revere Copper. We will gladly collaborate with you on specification and fabrication matters. Just get in touch with the nearest Revere Sales Office.

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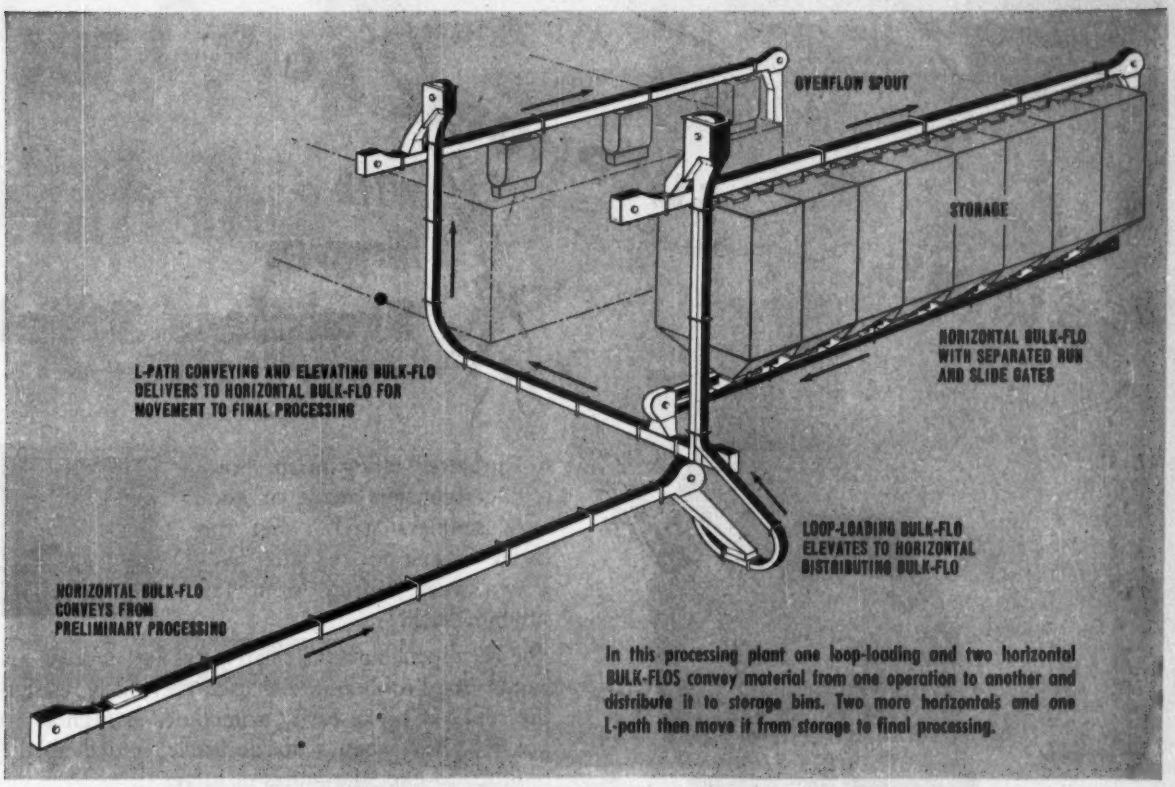
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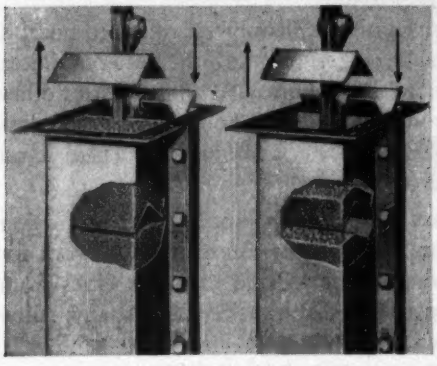
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to cut your handling costs

Now—with *one* fully enclosed assembly—you can replace several handling units in less space . . . at lower cost. BULK-FLO combines three functions in one, offers true versatility in bulk material handling.

Operating independently of internal pressure, its solid flights provide positive, variable movement of material even at less than full capacity. BULK-FLO is gentle, too—individual "compartments" protect the material.

There's a wide range of designs that can be engineered to match your system requirements. For complete information, call your Link-Belt office, or mail the handy coupon included here for your copy of Book 2475.

LINK-BELT

BULK-FLO
FEEDERS - CONVEYORS - ELEVATORS

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LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.



LINK-BELT COMPANY
Address your nearest office

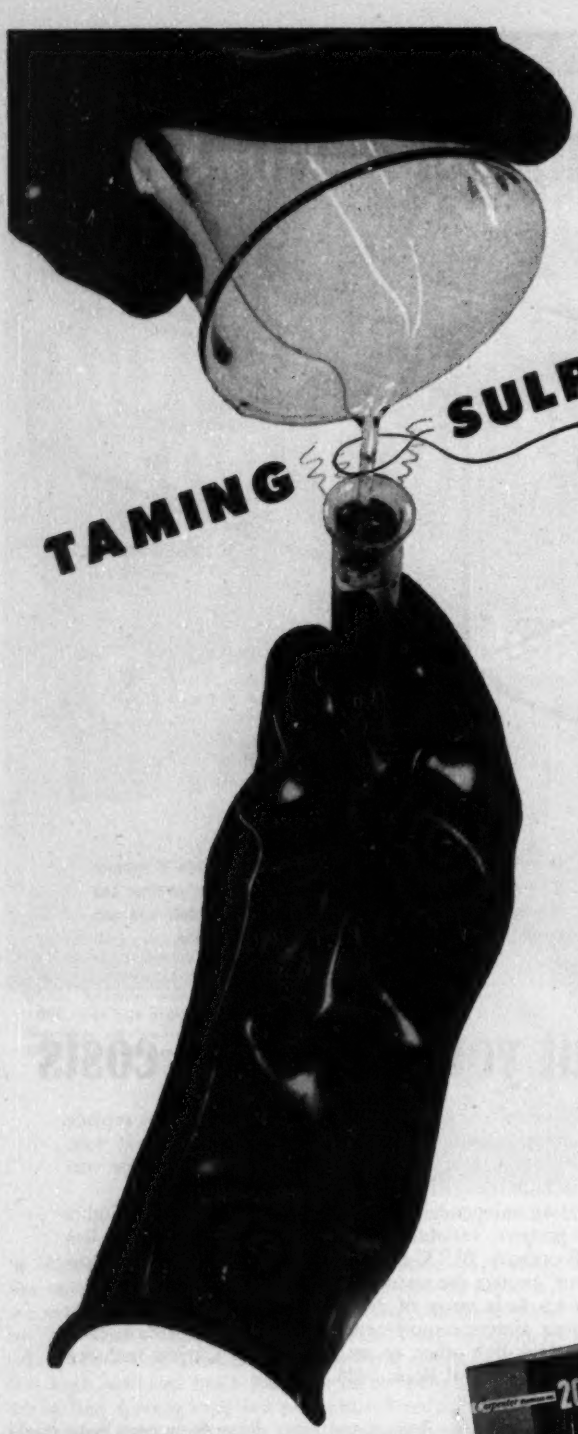
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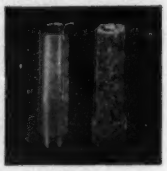
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Another Carpenter First

TAMING SULPHURIC ACID with a Super Stainless Steel





• The battery filling nozzle shown at the right was made of good 18/8 stainless steel . . . but this is the way it looked after only a two week beating from 12% sulphuric acid!

The battery manufacturer had a real headache on his hands. Hard rubber nozzles used previously resisted the acid but broke easily, sometimes as high as 10 per day. And when a nozzle broke, it tied up the production line 30 minutes or more.

Then he solved his problem by changing to nozzles made from Carpenter No. 20—the super stainless steel that handles sulphuric acid and a host of other strong corrodents. The left photo shows a Stainless No. 20 nozzle after five months' use. There is no sign of corrosion.

If you have a product or a process where corrosion is a problem, put Carpenter experience to work for you. Distributors are located in major cities from coast to coast. The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N.Y., "CARSTEELCO"



New 16-Page Book of Technical Data

For complete information on No. 20 and the jobs it can do, write us a note on your company letterhead and ask for the new Carpenter Stainless No. 20 book.

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STAINLESS TUBING & PIPE

Analysis · Tolerance · Finish

- guaranteed on every shipment

Improve Your Operations With This New Resin Kettle



DIRECT FIRED

SHORT HEAT-UP

HIGH FUEL ECONOMY

RADIANT "BLACK HEAT"

NO REFRACTORY WALLS

SAFE

PERFECT CONTROLLABILITY

QUICK COOL-DOWN

To heat kettles and autoclaves which process heat-sensitive materials Blaw-Knox engineers have developed a new oil-fired furnace of proven superiority. Through a unique arrangement of the burners and a pre-sooting of the heating surface, 75% of the heat is transmitted by radiation.

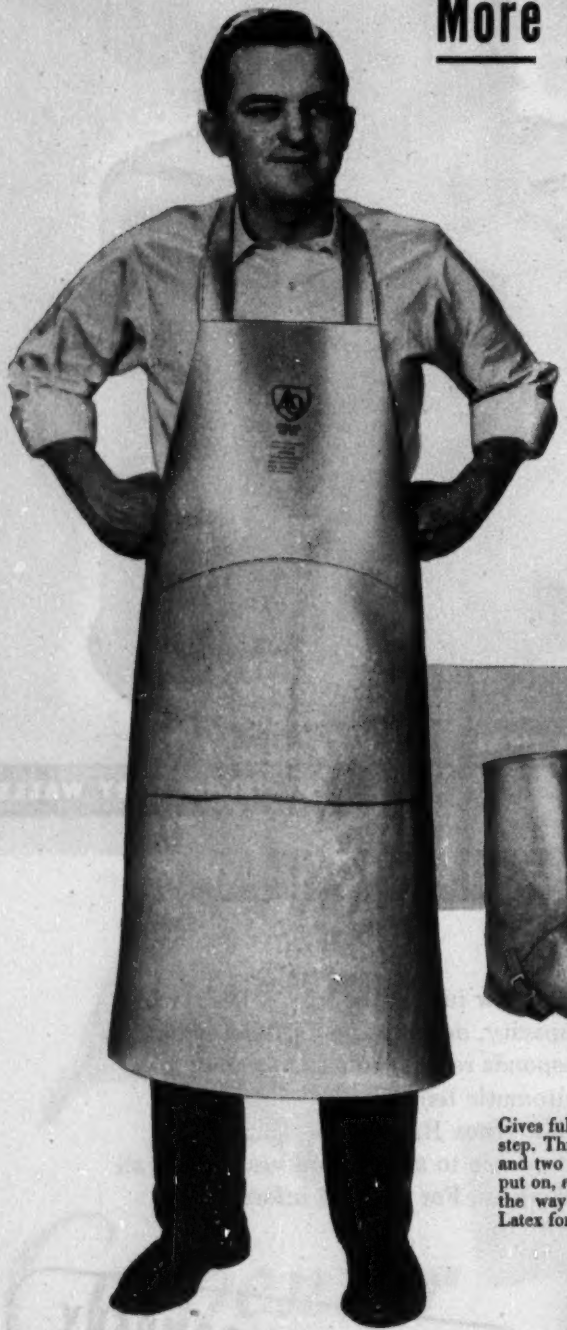
This new furnace has a low heat capacity, develops no local hot spots and responds rapidly to either manual or automatic temperature controls . . . Blaw-Knox Radiant Heating is adaptable to all reaction vessels and all processes. For detailed information write to

BLAW-KNOX COMPANY
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PITTSBURGH 22
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BLAW-KNOX

They're Longer-Lasting, Lighter, More Flexible!

NEOPRENE LATEX CLOTHING



Need protection for your workers against abrasion, oils, greases, acids and alkalis? These *high quality* garments of Neoprene Latex offer you big money's worth 5 ways:

1. They're *saturation coated* for long life. Not one or two coats but *seven.*
2. They're lightweight — no loaders present.
3. They're flexible in heat or cold.
4. They're styled to fit.
5. They're easy to clean.

Your nearest AO Safety Products Representative can supply you.



SLEEVE MODEL 18NL

18" long. Weight 9½ oz. per pair. Seam on each sleeve absolutely waterproof. Strong, durable elastic at cuff and top. For all wet work (as in canneries), grinding, bench and acid operations.

7X139NL SPAT

Gives full protection for ankle and instep. Three snap adjustments at top and two at bottom make spat easy to put on, adjust and remove. Coated all the way thru with 100% Neoprene Latex for your protection.

142DC APRON

42" long*. Recommended for use in the chemical and public utility industries, mining, dairies, meat packing.

*Also available in 30", 36", and 48" lengths.

American Optical

SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES



The toughest three-letter word in business

"But . . ."

The word a man uses when he starts by nodding yes and ends by saying no.

"But . . ."

The word on a Multiwall buyer's tongue just after he's said, "Well, as long as we order by specification, I guess one brand's as good as another . . ."

Executives who purchase more than 85 per cent of all Multiwalls have a big BUT there.

They testify* that there are many other considerations. Among the most important, the reputation of the manufacturer. They judge him by his record of reliability, his effort to meet delivery dates, his willingness to give a full measure of service.

We welcome the challenge of the toughest three-letter word in business. We believe the attention big buyers of Multiwalls pay to the *extra* factors—dependability, for instance—has a lot to do with their giving Union a greater proportion of their Multiwall business.

More so every day . . .

IT'S UNION FOR MULTIWALLS

**August, 1951 research study.*

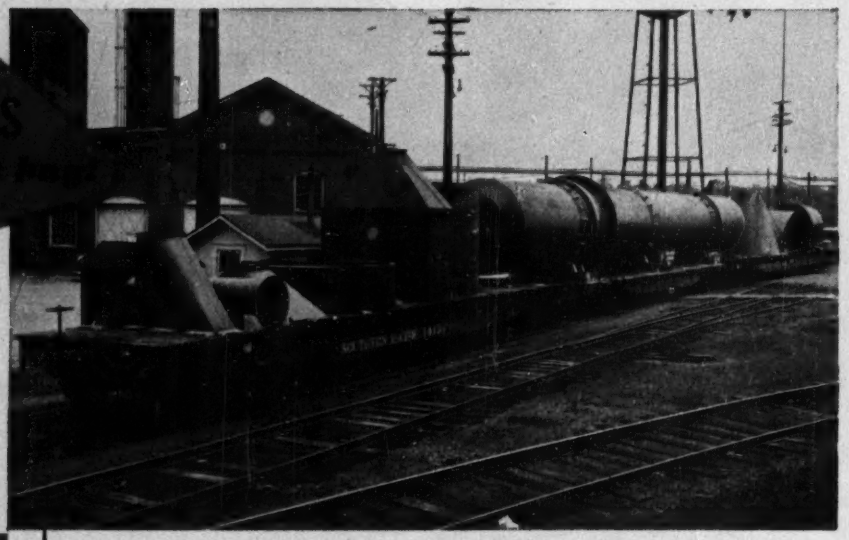
UNION BAG & PAPER CORPORATION • NEW YORK: WOOLWORTH BUILDING • CHICAGO: DAILY NEWS BUILDING

See Louisville for
CREATIVE DRYING ENGINEERING

PRODUCTION WILL BE UP 150%—COSTS DOWN 2/3's

WITH THIS NEW LOUISVILLE DRYER

KNOW
THE RESULTS
before you buy!



Installed Cost	$100,000
Annual Production (tons)	10,000
Drying Cost Per Ton	$ 3.11
Space Occupied	1,900 sq. ft.

Installed Cost	$ 95,000
Annual Production (tons)	25,000
Drying Cost Per Ton	$ 1.04
Space Occupied	1,000 sq. ft.

Ask for new treatise on subject of rotary dryers.

Other General American Equipment:
Turbo-Mixers, Evaporators, Dewaterers, Towers, Tanks, Bins, Filters, Pressure Vessels

PROBLEM: manufacturer wanted to improve drying operation. Costs high, production low.

SOLUTION: manufacturer called in Louisville engineers.

These engineers started the Louisville method for predetermining results . . . and for fitting the dryer to the job.

Step 1. *Louisville engineers completely surveyed plant operations and previous drying methods.*

Step 2. *Recommended dryer design was checked in Louisville laboratory in actual drying test.*

Step 3. *A double check with larger pilot plant equipment actually installed in customer's plant.*

Step 4. *All factors determined and solved, full scale drying equipment was fabricated.*

Step 5. *Final installation will be checked for mechanical perfection and drying efficiency to insure anticipated results and purchaser's satisfaction.*

SUGGESTION: Why not call in a Louisville engineer to look over your drying operation? There's no obligation . . . and the results may pay big dividends.

PROCESS EQUIPMENT DIVISION
GENERAL AMERICAN
TRADE MARK

LOUISVILLE DRYING MACHINERY UNIT
Over 50 years of creative drying engineering
GENERAL AMERICAN TRANSPORTATION CORPORATION
Dryer Sales Office: 139 South Fourth Street, Louisville 2, Kentucky • ***General Offices:*** 135 South LaSalle Street, Chicago 90, Illinois • ***In Canada:*** Canadian Locomotive Company, Ltd., Kingston, Ontario
OFFICES IN ALL PRINCIPAL CITIES

WITH HOSE, TOO

It pays to order from your Goodyear Distributor

STANDARD HOSE REPLACES SPECIAL CONSTRUCTION

This company had been using specially-built, heavy, plied-up type hose requiring special construction at a high price. The Goodyear Distributor called in the G.T.M.—Goodyear Technical Man—found standard ORTAC hose with oil-resistant cover could do the job at a fraction of the cost.

PREMATURE HOSE FAILURE ENDED

A sand and gravel company was troubled with premature failure of water and sand discharge hose, caused by slight suction set up when pumps were started. The Goodyear Distributor and the G.T.M. recommended DIVERSIPIPE—which has served over two years and is still going strong.

Here's why it pays to order from your local Goodyear industrial rubber products distributor.

Replacement orders filled when you need them from convenient, local stocks.

One order, *one* bill, *one* central responsibility for all your Industrial Products requirements.

You save on valuable stockroom space, because your local distributor maintains a full stock of the items he knows you need.

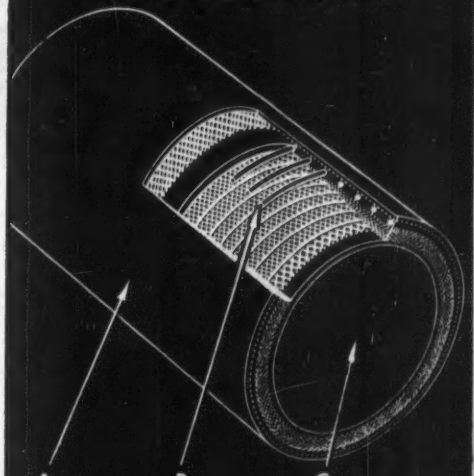
Double assurance of satisfaction because the distributor and Goodyear stand behind the products he sells you.

Goodyear, Industrial Products Div.,
Akron 16, Ohio

GOODYEAR INDUSTRIAL PRODUCTS

GTM-Specified DIVERSIPIPE

for Sand and Water Discharge Service



Ortac—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

We think you'll like
THE GOODYEAR TELEVISION PLAYHOUSE
every other Sunday—NBC TV Network

GOODYEAR

THE GREATEST NAME IN RUBBER

You can put full confidence in them!

THESE McQuay REPRESENTATIVES



No. 3 of a series of 3 advertisements.

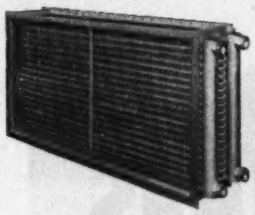
McQuay INC.

MAKES THE SEASONS COME TO YOU

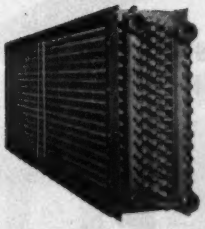
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THIS COMPLETE LINE OF FAMOUS McQuay PRODUCTS



WATER COIL



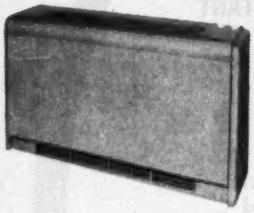
CLEANABLE TUBE WATER COIL



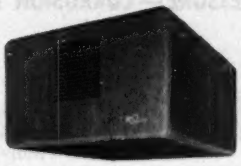
DIRECT EXPANSION COIL



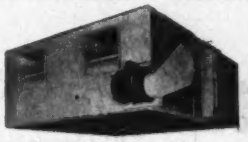
"BLAST" HEATING STEAM COIL



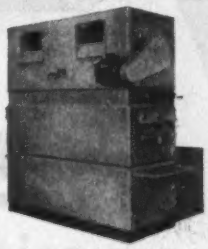
SEASONMAKER (FLOOR)



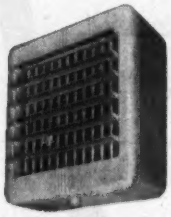
"RH" AIR CONDITIONER



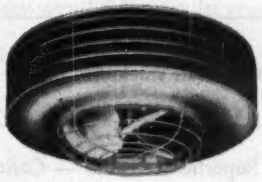
AIR CONDITIONER
(Suspended Model)



AIR CONDITIONER
(Floor Model)



HORIZONTAL UNIT HEATER



DOWN FLOW UNIT HEATER

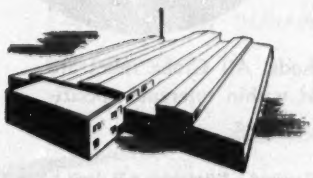


BLOWER TYPE UNIT HEATER
(Suspended Model)

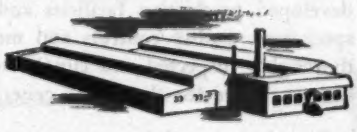


BLOWER TYPE UNIT HEATER
(Floor Model)

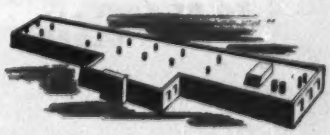
McQuay representatives, in all principal cities throughout the United States, are qualified by long experience and training to help you satisfy all of your air conditioning and heating requirements. For cooperation in making the sale, technical advice, or getting the job done on time, consult the McQuay representative in your territory. Available to you through him is the complete line of McQuay products, featuring famous Ripple-Fin construction—a McQuay exclusive, assuring maximum heat transfer efficiency and dependable performance.



PLANT 1—1600 Broadway N. E.
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PLANT 3—4th and Park Ave.
FARIBAULT, MINN.

GLOBE

specialization gives you
"Tops in Quality"

ALLOY STEEL TUBES

SEAMLESS — MECHANICAL — PRESSURE — CORROSION RESISTANT

TYPICAL ANALYSES:

Carbon	5 Chrome ½ Moly
Carbon ½ Moly	7 Chrome ½ Moly
½ Chrome ½ Moly	8 Chrome ½ Moly
1 Chrome ½ Moly	8 Chrome 1 Moly
1¼ Chrome ½ Moly	9 Chrome 1 Moly
2 Chrome ½ Moly	3% Nickel 7% Nickel
2¼ Chrome 1 Moly	5% Nickel 9% Nickel

AISI Types: 304-321-347-316-309-310-405-410-430-443-446

Analyses to meet conditions where heat, corrosion, pressure and structural strength are involved.

SIZE RANGE — WALL THICKNESS:

½ to 6 inches O.D. — wall thickness .035 to 1,000 inch.

TYPICAL APPLICATIONS:

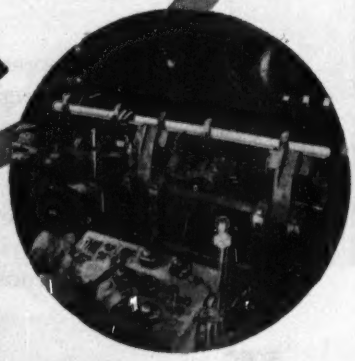
Pressure tubes — Superheater tubes — Condenser tubes — Still tubes — Evaporator tubes — Barrel tubes — Oil-well Pump Barrels — Mechanical tubes — Aircraft tubes — Propeller tubes — Rollers for Transmission Chains.



Globe engineers gladly give you the benefit of specialized knowledge of stainless steel tubing in a wide range of services and applications — to improve your product — to cut costs.

TO BE SURE . . . SPECIFY GLOBE

The heating, piercing, rolling of seamless tubes is controlled at every step for uniformity, close tolerance.



WHEN you specify Globe, you get uniform high quality alloy steel tubes, the product of highly developed production facilities and specialized quality controls and methods. All Globe tubes are thoroughly inspected and closely held within tolerance specifications. Write for the Globe general catalog.

GLOBE STEEL TUBES CO.

Milwaukee 46, Wisconsin Chicago • Cleveland • Philadelphia • St. Louis • New York Detroit • Denver • Houston • San Francisco • Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high purity ingot iron) seamless tubes — Globe Welding Fittings.

NOW AVAILABLE...



from CARBIDE AND CARBON'S expanded production facilities

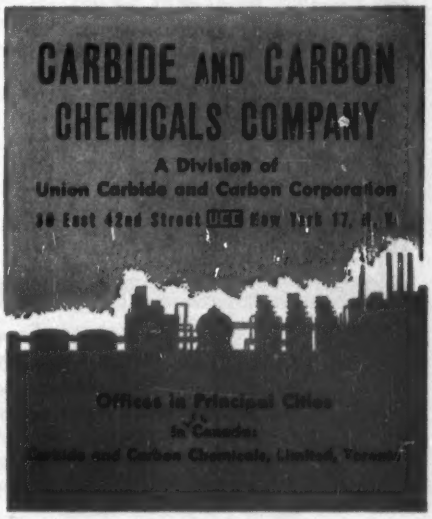
Ethanolamines are available now in greatly increased quantities—a result of added facilities for production of Ethylene Oxide.

Mono-, di-, and triethanolamines have been produced by CARBIDE and CARBON since the 1930's. CARBIDE's long experience in production of these basic materials assures you of high, uniform quality.

Use ethanolamines for acid gas absorption, for solubilizing 2,4-D, and for making synthetic detergents, soluble metal-cutting oils, corrosion inhibitors, and other amine derivatives.

Drum stocks of ethanolamines can be delivered promptly from warehouses in principal industrial areas. Compartment and full tank car lots can be shipped promptly to meet your needs.

For complete information, phone or write our nearest office.



take a closer look at

Stainless STEEL



Don't be "penny wise and pound foolish" where stainless steel piping is concerned.

The most economical choice does not always imply the least initial cost as working pressure, methods of joining, installation costs and allowance for loss by corrosion are critical factors. This is particularly true where costs resulting from failures in service—replacement of equipment and lost production due to down time—may exceed the initial cost of the piping.

Figure A

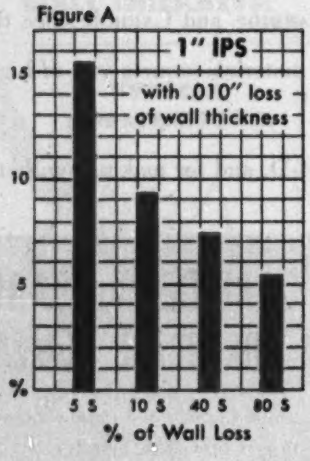


Figure B

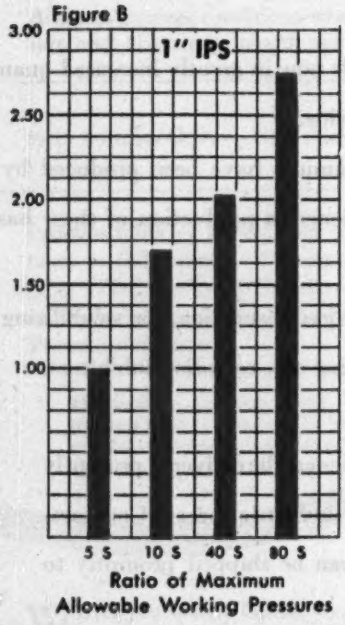
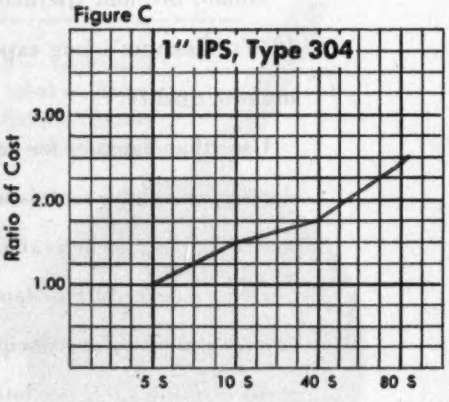


Figure C



CORROSION RESISTANCE

For long service life it is advisable to allow for some loss in wall thickness where stainless piping is employed to combat severely corrosive conditions. As shown in Figure A even a small loss means an appreciable percentage loss of wall thickness in the lighter weight schedules.

WORKING PRESSURES

As shown in Figure B, the heavier pipe schedules permit higher working pressures, thus perhaps permitting the use of smaller diameter piping, or offering greater flexibility for subsequent changes in operational procedures.

PIPE SIZE Schedules

1" IPS

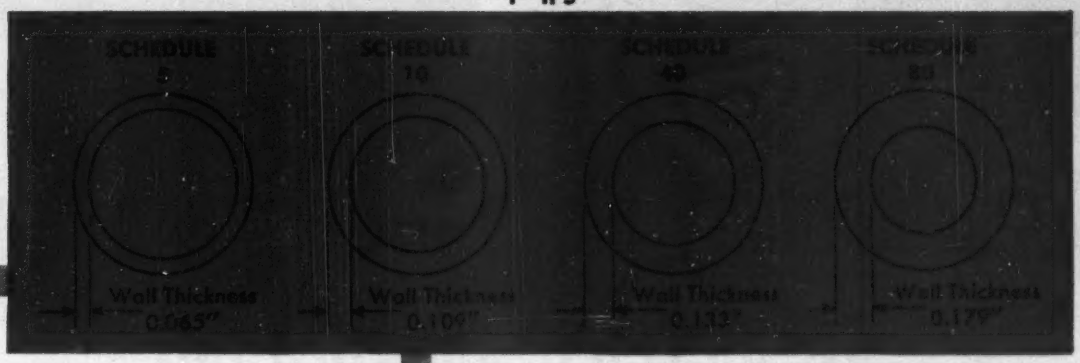
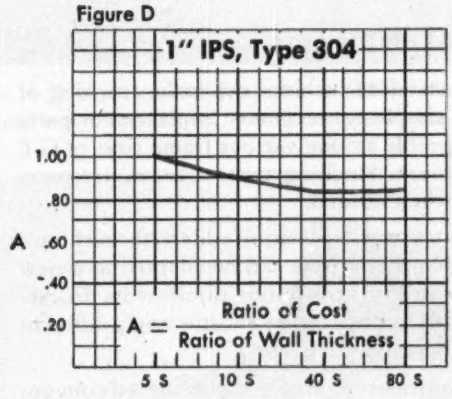


Figure D



COSTS

Although the lighter schedules cost less, as shown in Figure C, you actually get more for your money with the heavier schedules because the ratio of increase in cost is *less* than the ratio of increase of wall thickness (Figure D).

Methods of Joining & Costs of Installation

From the standpoints of economy and ease of installation, it is extremely important that attention be given to methods of joining, fittings, etc. because:

1. Schedule 40 IPS is the lightest weight pipe specifically designed for threading.
2. Fittings which provide a good thread and also afford structural strength at the joint are not commercially available for lighter weight pipe.
3. Field welding of thin wall pipe is difficult.
4. Misalignment of connections can cause high installation costs.

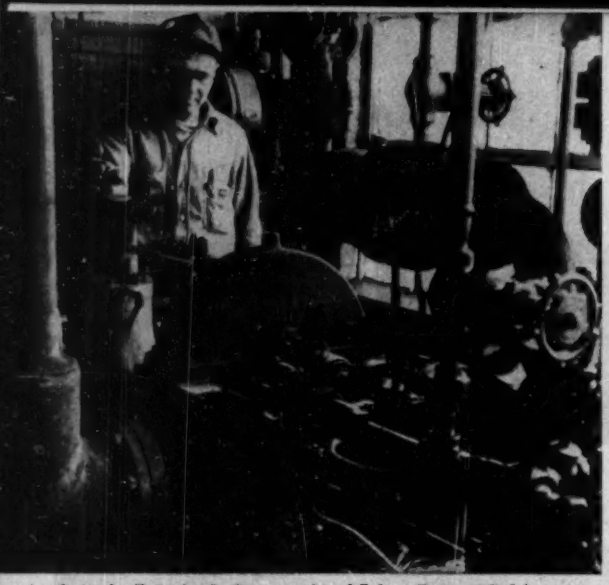
While various types of fittings are available for the lighter weight pipe schedules, they should be examined carefully as to initial costs, installation cost, working pressure permitted and ease of adaptation to existing lines.

Whatever your stainless piping problems, Mr. Tubes—your B&W Tube representative—can provide valuable assistance. Consult him for advice on the stainless piping or tubing that will afford optimum cost-life ratio under your service conditions.

TA-1709 (G)

B&W STAINLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing



At Sohio's Toledo Refinery, this 15 hp, Type DP-16 turbine with non-sparking enclosed overspeed governor, safely pumps propane in an explosive atmosphere.



Mr. Eugene Ten Eyck and Mr. E. J. Bissonnette of Sohio Refinery discuss stocking of interchangeable parts for the Type DP turbines installed at the Refinery.

Sohio Refinery picks G-E turbine drives to increase oil thru-put

Engineers at Sohio's Toledo Refinery installed two G-E mechanical-drive turbines to help eliminate a bottleneck in refinery operations. A General Electric Type DP-20 turbine increased oil thru-put on one pump at Sohio by 75%, when it replaced older drive equipment. Total daily thru-put of the one pump now equals the former capacity of two pumps.

INSTALLED IN HAZARDOUS AREA

Sohio also installed a G-E Type DP-16 turbine in an explosive atmosphere to pump almost pure propane. The enclosed, non-sparking overspeed governor and the positive trip-throttle valve (which shut off all steam flow in case of overspeed) reduce hazards in this area. The turbine, which operates twenty-four hours per day, has required no maintenance during its first year of service.

VIBRATION REDUCED

Replacement of previous drive equipment with a G-E turbine now assures longer life to other machinery in the area. For G-E turbines with their center-line support and rigid assembly of buckets are now contributing to smooth operation at the refinery.

INTERCHANGEABLE PARTS

Use of G-E standard turbines can make stocking of spare parts a simple matter—most replacement parts are interchangeable among various frame sizes of G-E Type DP turbines. Stocking costs are cut, yet parts are available when needed.

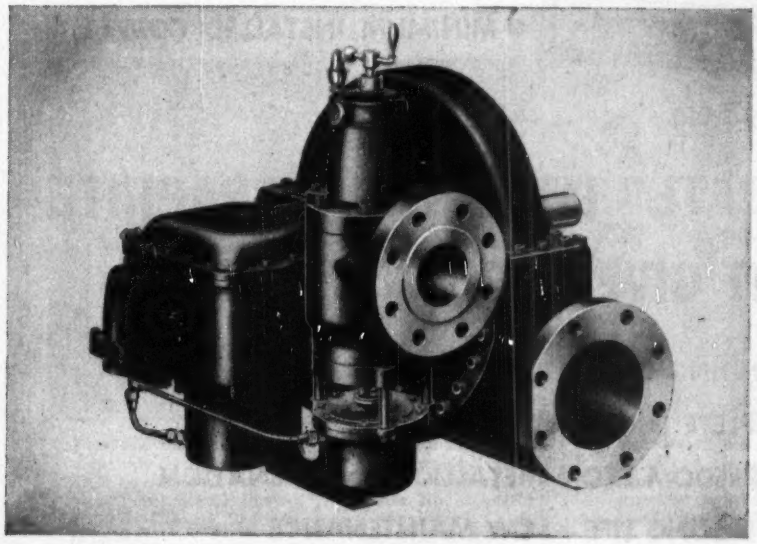
This same parts standardization adds to the turbine's flexibility—often the turbine can be adapted to a new plant application with only minor adjustments. Horsepower range can be changed by substituting a different nozzle plate and valve parts.

For more information about the many advantages which these standardized turbines offer, call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-56, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC



Mr. A. Bourgeois, process foreman at Sohio Refinery, adjusts pump valve. Type DP-20, 125 hp turbine increased by 75% the oil thru-put of this pump which supplies crude oil for the distillation unit.

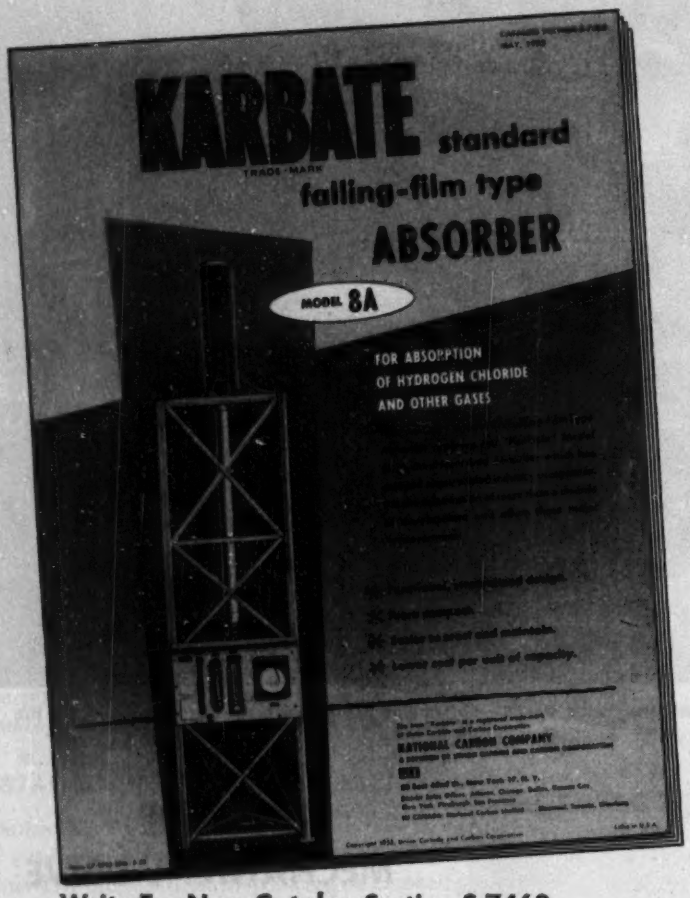


Type DP MECHANICAL-DRIVE TURBINE

This Type DP turbine is one of General Electric's line of mechanical-drive turbines designed for driving pumps, compressors, blowers, etc. Their sturdy construction and many safety features make them ideal for industries having process steam requirements.

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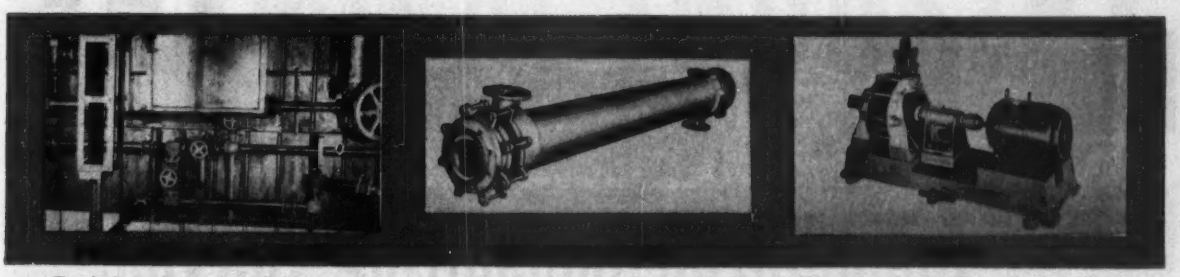
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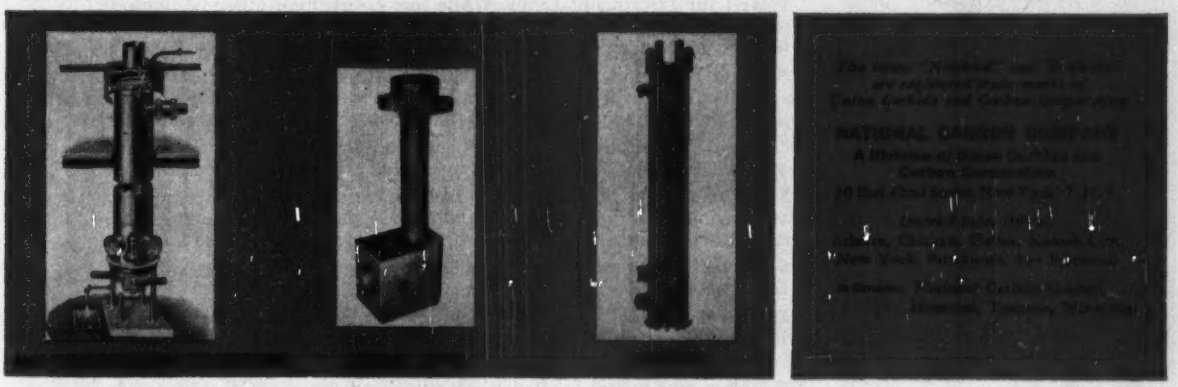
The centrifugal pump for handling corrosive fluids. Rugged, trouble-free design. Handling capacities to 800 G.P.M. Catalog Section S-7200.



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New "Karbate" coolers feature standardized, sectional construction... high heat-transfer rate... low initial cost Catalog Section S-6820.

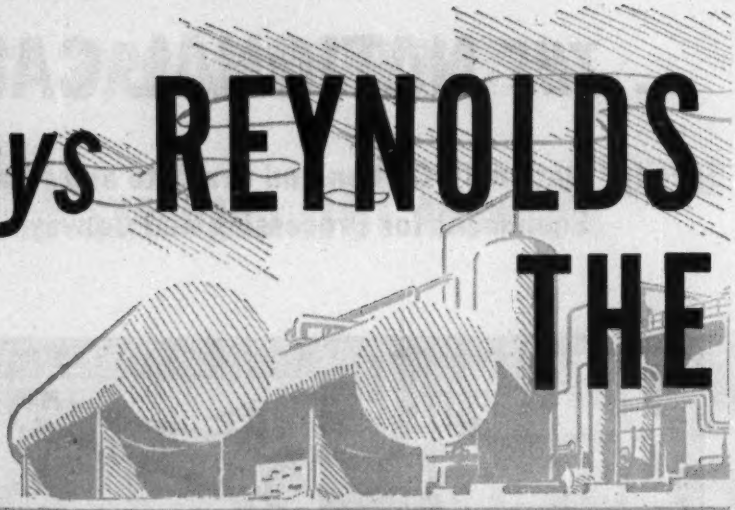


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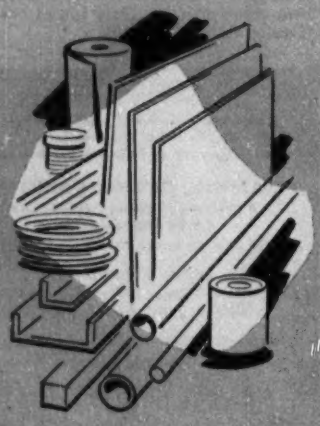


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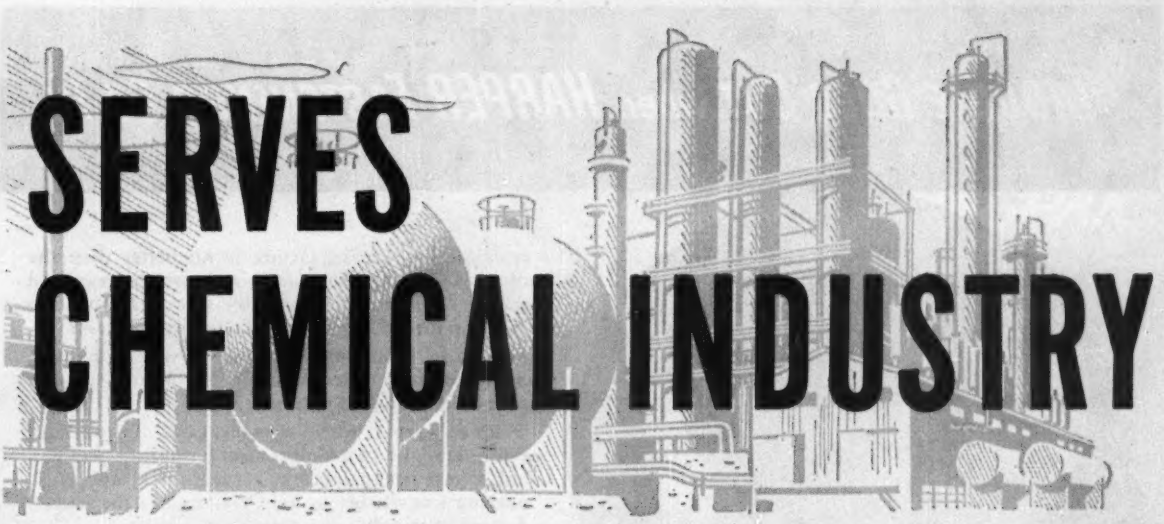
Sheet and Plate. For process vessels, trays and bubble caps, storage tanks, and building applications aluminum has many advantages. Its non-sparking characteristic is important around highly volatile products.

Structurals, Rod and Bar are ideal for lightweight piping supports, framework, ladders and scaffolding.

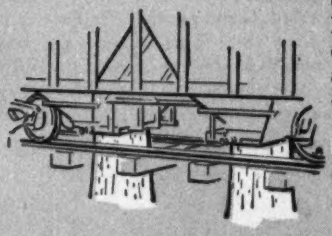
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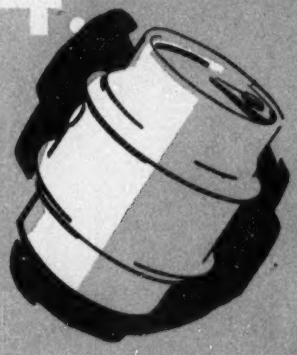
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U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

Research Links Methionine With Male Sex Hormone

Evidence of a possible relationship between methionine and testosterone — the male sex hormone — is seen in the results of recent studies of induced fatty liver infiltration, it is reported.

It is known that ethionine, an antagonist of methionine, prevents methionine from acting. Ethionine, when present, therefore causes a deficiency of methionine, one manifestation of which is fatty infiltration of the liver. It has also been found that methionine can counteract this effect of ethionine in rats and can protect the animal against death. Other amino acids are ineffective in this respect.

The new investigations have shown that testosterone minimizes the fatty liver infiltration due to ethionine. The effect of the hormone in opposing a methionine-antagonist is thought to be significant in that it suggests a link between methionine and the male sex hormone. This in turn suggests the further possibility of a relationship that methionine might have in influencing the body's production of testosterone or in taking its place in some biological mechanisms.

New Method Deodorizes Qualitative Analysis

Elimination of hydrogen sulfide and attendant odors from future qualitative analysis laboratories may be indicated in a recently published book on new analytical separation techniques. The book, which is reported to be arousing a great deal of interest, deals with a method for early removal of troublesome tri- and tetravalent metals through a basic benzoate separation. Students who have used the method are said to have found it faster, easier, and comparable in results to the older, hydrogen sulfide method.

Plastic Improves Ancient Plant Propagation Method

A vinyl film, coated with a mixture of hormone, insecticide, fungicide, and fertilizer, was recently marketed as an aid to gardeners who propagate trees, shrubs, and other plants by 'airlayering'. The method, which has been used for centuries in one form or another, consists of selecting a branch for rooting, peeling away an inch-wide strip around the branch, and then covering the strip with moss and a wrapping of film. After a certain period of time, roots will have sprouted inside the covering, and the branch is ready for cutting and planting. The new impregnated film is claimed to speed up the process and to increase chances of its success.

U.S.I. Helps Educate Farmers In Best Insect Control Methods To Keep Grains For Food Clean

Pyrenone Insecticides Have Important Role in the Insect Control Program, Affording Protection Against, Instead Of Cure for, Infestion of Grains Destined for Storage

In cooperation with the various farm groups and college extension services, U.S.I. is currently taking part in a major country-wide project to educate grain farmers in efficient insect control methods. The project is being undertaken in anticipation of demands for more rigid inspection standards to provide cleaner grains for human consumption.

Insect Control a Prime Factor

Tighter supervision will make it imperative that everyone connected with the production and marketing of grain be thoroughly familiar with all factors affecting grain quality.

Foremost among these factors is the presence or absence of insects — whether alive or dead. Under the new standards, for example, an elevator will be less likely to purchase grain containing weevils without docking it. Tighter controls and inspection prevent such grain from being sold for food purposes.

Since a large share of the responsibility for clean, insect-free grain rests with farmers, U.S.I. is helping to make available to them complete information on the latest and most efficient techniques for dealing with the insect problem.

MORE

Wanted — More Information For Potential Chemists

A recent survey by the Manufacturing Chemists' Association indicated that most science teachers feel they need more information in order to advise students about opportunities and careers in the chemical and chemical engineering professions. A spokesman for the Association points out that chemistry is vitally important to the nation's future. It is therefore imperative that potential future scientists be made fully aware of the opportunities for personal achievement and public service in the field.

In line with steps now being taken throughout the chemical industry to fill this need for more information, U.S.I. will be glad to supply interested teachers and students with material on any of the company's diversified line of industrial chemicals.



Protecting grain from the farm to the consumer from the infestations of insects lurking in storage and shipping facilities all along the way is a major problem of the grain trade. Pyrenone Protectants provide a preventive program for accomplishing this protection without toxic hazards.

★ U.S.I. CHEMICAL NEWS ★

CONTINUED

Best Insect Control Methods

Educational Programs Show How

As one example of how the educational project is working, a series of meetings is currently being held in five key centers of the Kansas wheat belt by the Kansas Wheat Improvement Association and the Kansas Extension Service. Authorities from Kansas State College are on hand at these meetings to explain the entire program of weevil control, including bin spraying, bin cleaning, fumigation, and other techniques.

An important part of each meeting is devoted to a showing of U.S.I.'s motion picture, "Beating the Weevil", which shows the techniques of storage insect control with Pyrenone. U.S.I. representatives are also on hand to answer questions and to supply additional information.

Why Pyrenone is Important

Pyrenone insecticides have a prominent part in the entire insect control project due to the fact that they afford protection against, instead of cure for, the problem. With the new inspection standards, it is equally important that grain sold for food purposes be free of dead insects as well as live ones. Three insect emergence holes in ¼ pint of wheat — about 4200 kernels — are enough to rule a whole shipment as contaminated and downgraded for feed purposes only. Hence, killing the insects in infested grain solves only half the problem: they must be stopped before infestation begins.

With Pyrenone, the farmer is assured of this kind of protection. A single application stops insects cold at the start, keeps them out of clean grain, and prevents any future infestation, even when the grain is stored in open bins or cribs. Application techniques are easy, and only one treatment is required for season-long protection.

In addition to grain protectant formulations, Pyrenone maintains protection literally from the farm to the family, the ultimate consumer. It is formulated in mill sprays and box car sprays, and it is impregnated into paper which is used to package foods.

Adapt Shell Molding To Magnesium Casting

A recent Government report indicates that magnesium alloys can now be cast successfully in shell molds — a process that has not been feasible until now. Shell molds are thin-walled molds of plastic-bonded sand which are well adapted for mechanization and which produce smooth, accurate castings. Previously, they could not be used with magnesium because of the molten metal's high chemical reactivity toward all the principal materials present — air, moisture, and sand.

The report details research that was undertaken in the use of various materials as inhibitors for these reactions and indicates which ones proved most satisfactory. Various plastic materials and mixing procedures were also investigated, and the report includes findings and recommendations on this phase of the process as well.

Carbon, Silica Gel Packet Doubles Food Shelf-Life

Small packets of activated carbon and silica gel, for inclusion in food packages to double the shelf-life of potato chips, nuts, candies, and other moisture-sensitive products, are now available to food manufacturers, according to a recent announcement. The packets were developed as a result of heavy losses to producers of such foods during hot, humid summer months.

Purpose of the silica gel is to absorb moisture which enters the package; activated carbon is included to absorb unpleasant odors that develop even when these foods are sealed and protected from moisture.

The protective agents are enclosed in a small perforated cellophane bag to eliminate the danger of their being consumed with the food.

Market tests during a Florida summer are said to have proved that potato chips packaged with the packet stay fresh and crisp from 10 to 14 days longer than those packaged in the usual manner.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U. S. I.

To hold thermometers upright against the sides of beakers, small, inexpensive stainless steel clamps are now available. Clamps allow thermometer adjustment to any height, hold it steady even when the solution "bumps". **(No. 910)**

A new rubber-base enamel overcomes problem of attacks of moisture, fumes, and caustic cleaning compounds on machine surfaces by providing a tight, chemical resistant coating that is easily applied and quick drying, the manufacturer claims. **(No. 911)**

A self-contained portable electric melting furnace for melting, alloying, and casting small quantities of metals weighs 6¾ lbs., has a built-in pyrometer, and can be lifted easily to pour off melt. **(No. 912)**

To drain flooded basements, excavations, tubs, etc., a simple portable attachment for garden hose operates on normal water pressure to drain up to 300 gallons per hour, it is claimed. **(No. 913)**

A new automatic fire alarm system for homes, factories, warehouses, can be set to activate at any temperature up to 225° F., discriminates between normal and abnormal heat rise, and resets itself automatically after activation. **(No. 914)**

A rust inhibitor for incorporation in salt used for de-icing streets and roads, is said to protect vehicles from salt corrosion. Product is also effective in other salt uses, such as in water softeners and food processing and packing plants. **(No. 915)**

Pen-size hypodermic grease guns and oilers are now available in a kit for lubrication of small machinery parts in home, office, or factory. Tools can also be used for delicate cementing and gluing operations. **(No. 916)**

Ordinary paper labels can now be adhered to polyethylene containers with a new adhesive which can be applied in conventional labeling machines, eliminating necessity for stencilling and silk-screening, according to the manufacturer. **(No. 917)**

A new quick-setting thermoplastic cement requires no air, will set under water, does not shrink, expand, or crack, and permits bonding of metals, wood, plaster, porcelain, stone, concrete, and glass, it is claimed. **(No. 918)**

To eliminate foaming in laboratory distillations, and to overcome "parallax" errors in burette reading, a silicone formulation is now packaged in an aerosol bomb for releasing small quantities at a time as needed. **(No. 919)**

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FOR REAL HELP TO SMALL BUSINESS

It is ironic that one of the first jobs of the Eisenhower administration, so widely, and erroneously, tagged as a "big business" administration, must be to go to the relief of small business. This is necessary because the preceding administration, while continually proclaiming its tender regard for small business, actually impaired gravely the ability of small business to carry on successfully. This it did in the necessary haste of devising an emergency tax program to finance rearmament and the Korean War. Now the new administration must revise this tax structure to give small business a chance to make its key contribution to an expanding American economy.

How Taxes Hurt Small Business

Since the outbreak of the Korean War, small business has been handicapped by two principal features of the emergency tax program:

1) Many small firms are unable to retain enough of their earnings to provide for expansion because these earnings are drastically limited by the excess profits tax.

2) Small companies have received a very small share of the tax concessions allowed by the federal government to encourage construction of defense facilities.

A small business that succeeds and hence grows is particularly hard hit by the excess profits tax. That tax, of course, applies to corporations having a net income of more than $25,000 per year. It results in taking up to 82 cents on every dollar of profit that the company earns above what is called an "excess profits credit." For most small companies the credit depends on what was earned in 1946-49. This creates an element of gamble and discrimination in determining the amount of tax to be paid. Time has proved that it is impossible to select a base period for the tax that is fair to all companies. A young company starting in 1946-49 is peculiarly vulnerable, as its earnings in that period were necessarily low. Even on modest earnings today, it would pay a high excess profits tax.

It is true that Congress wrote into the excess profits tax law provisions to lessen the impact of the tax on growing companies. However, none of these provisions in practice has given much relief to small business.

"Relief" Provisions Give Little Relief

Small firms rely almost entirely on retained earnings to provide funds for improving their plants and equipment. They get very little help from the provisions (1) that no more than 70 per cent of total profits can be taxed away, (2) that additional earnings are allowed on an increase of invested capital or (3) that growing companies are allowed a

rate of return on capital equal to the industry average.

Most large firms can obtain additional funds in the securities market. But small firms find it difficult to increase their capital by selling securities, since investors generally prefer the stocks or bonds of nationally known and seasoned companies. Few small companies, therefore, can reduce their tax burdens by increasing their invested capital, and few can meet their needs for equity capital if their rates of profit are no higher than those of the leading companies which generally set the average profit.

Small business has been equally at a disadvantage in the matter of accelerated depreciation for tax purposes. The government has encouraged a great expansion of our industrial plant, despite the very high rate of taxation on corporate earnings, by granting certificates of accelerated amortization on new plants built to support the defense program. These certificates allow business to charge off the cost of defense plants at a rapid rate. This decreases the earnings that are subject to taxes, and so increases the part of the earnings that may be retained in the business.

Growth Is Stifled

But most of these tax concessions have been made to large firms especially equipped to handle the complex problems of defense production. Of the $12 billion of new facilities so far approved for fast amortization, only 11 per cent are for companies with less than 500 employees, although the share of such companies in the normal civilian business is about 30 per cent. In only 2 of 12 industries studied by the Small Defense Plants Administration were small firms receiving what was estimated to be a fair share of the total tax amortization awarded.

Because they are unable either to retain enough earnings after taxes or to step up their depreciation allowances, most small firms are unable to keep up in the race to expand and modernize plant capacity. The Small Defense Plants Administrator, in his report to Congress, emphasized that small companies have been unable to do their full part in the defense program for lack of capital.

The Council of State Chambers of Commerce recently published an eight-state survey showing widespread cutbacks of plans for new plants by small and medium-sized companies. According to this report, "high federal taxes enacted since the beginning of the Korean War appear to be placing an effective brake on the rate of industrial expansion in all the states surveyed and probably in the 48 states generally . . . It is principally the small and medium-sized companies whose growth is being stifled."

Some Ways to Help

The first step to relieve small companies should be to free them from the excess profits tax. The nation as a whole would be far better off if the excess profits tax were allowed to die as scheduled on June 30, since the tax promotes waste as it stifles incentives. It is quite possible, however, that the politics of tax reduction, as opposed to the economics, will prevent the elimination of the tax during 1953.

If the tax is extended, provision should be made for a much broader exemption to smaller corporations. If net income up to $100,000 a year, which in these days still constitutes small business, were exempted from the tax, the loss of revenue to the government would be about $175 million. This relatively small amount could easily be offset by an increase in employment and incomes if small business is freed from its financial strait jacket and allowed to expand. Careful attention should be given also to the possibilities of allowing a higher rate of return on the first $1 million of capital (roughly the amount it takes to provide 100 jobs) and of making special accelerated depreciation allowances to smaller firms. This is a matter so important that we shall return to it in a future editorial.

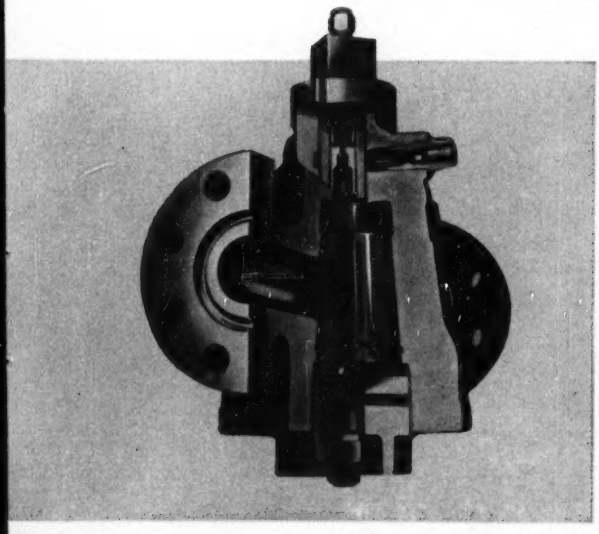
Relief for small business—relief from a financial paralysis that has kept it from playing its dynamic part as a growth element in our economy—would do much to give the lie to the notion that the Eisenhower administration is a "big business" operation. Much more important, it would be a long stride toward releasing the dynamic energies of many small businesses and businessmen to forward a continuing and expanding prosperity.

McGraw-Hill Publishing Company, Inc.



HARD-TO-HOLD HYDROCARBONS?
Nordstrom *LUBRICANT SEALS* Them

In this case, it's one of the world's largest butane and propane tank batteries that Nordstrom valves are controlling. But it might be any one of hundreds of volatile hard-to-hold hydrocarbons.

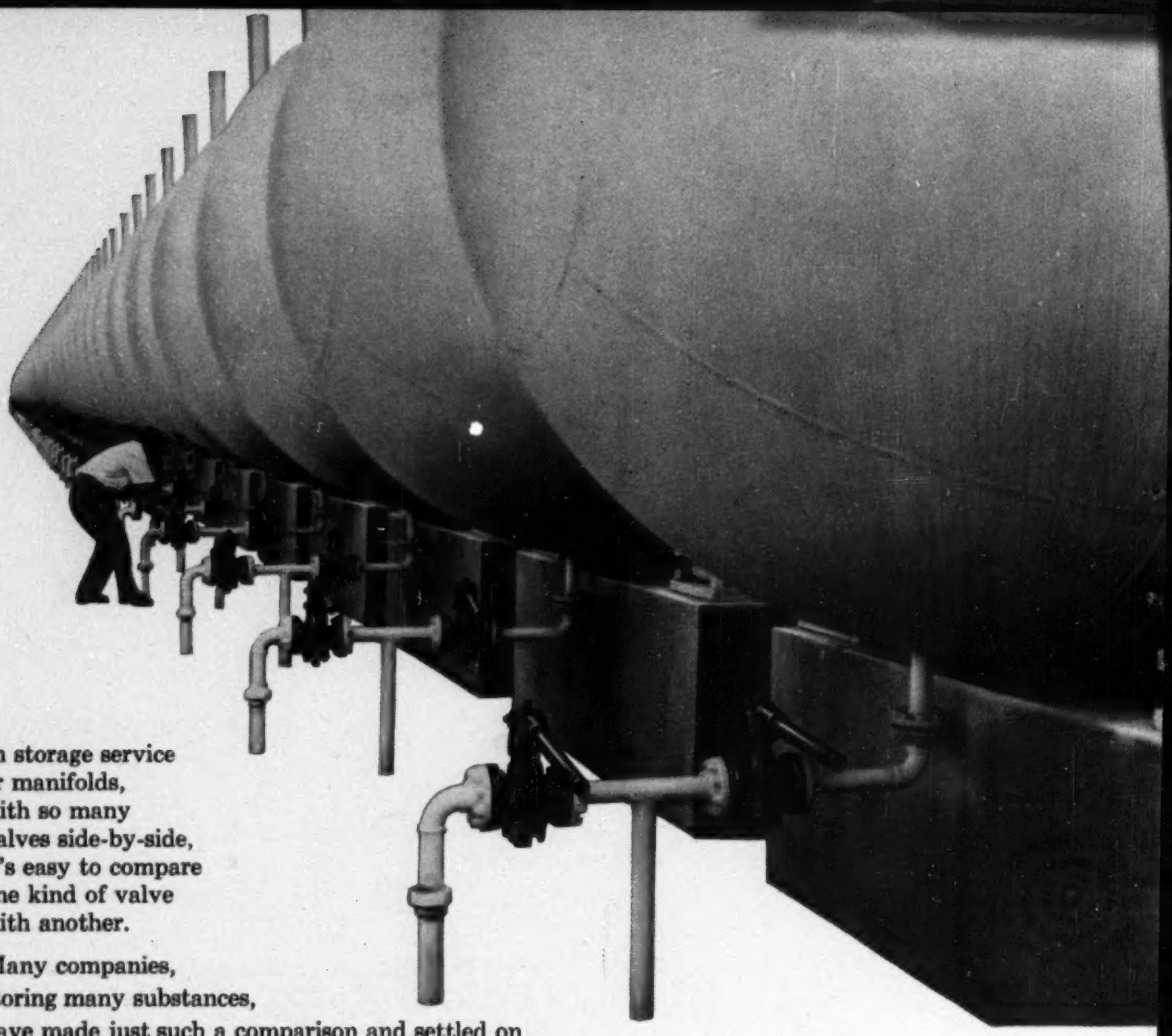


Nordstrom valves don't depend on metal-to-metal contact to check these light, tricky gases and fluids. Nordstrom valves have a seal of plastic lubricant around all seating surfaces—double protection against leaks of inflammable liquids or vapors.

Be sure—really sure. Use Nordstrom valves and genuine Rockwell lubricants. That's the *right* way—that's the *tight* way.
Rockwell Manufacturing Company,
Pittsburgh 8, Pa.

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product



In storage service
or manifolds,
with so many
valves side-by-side,
it's easy to compare
one kind of valve
with another.

Many companies,
storing many substances,
have made just such a comparison and settled on

NORDSTROM VALVES

Since Nordstrom valves are doubly sealed with an internal film of plastic lubricant, they are doubly protected against the little leaks that can become big dangers. Nordstrom valves operate quickly, too, for it takes only a quarter turn of the plug to change from fully open to fully closed.

AND ROCKWELL LUBRICANT

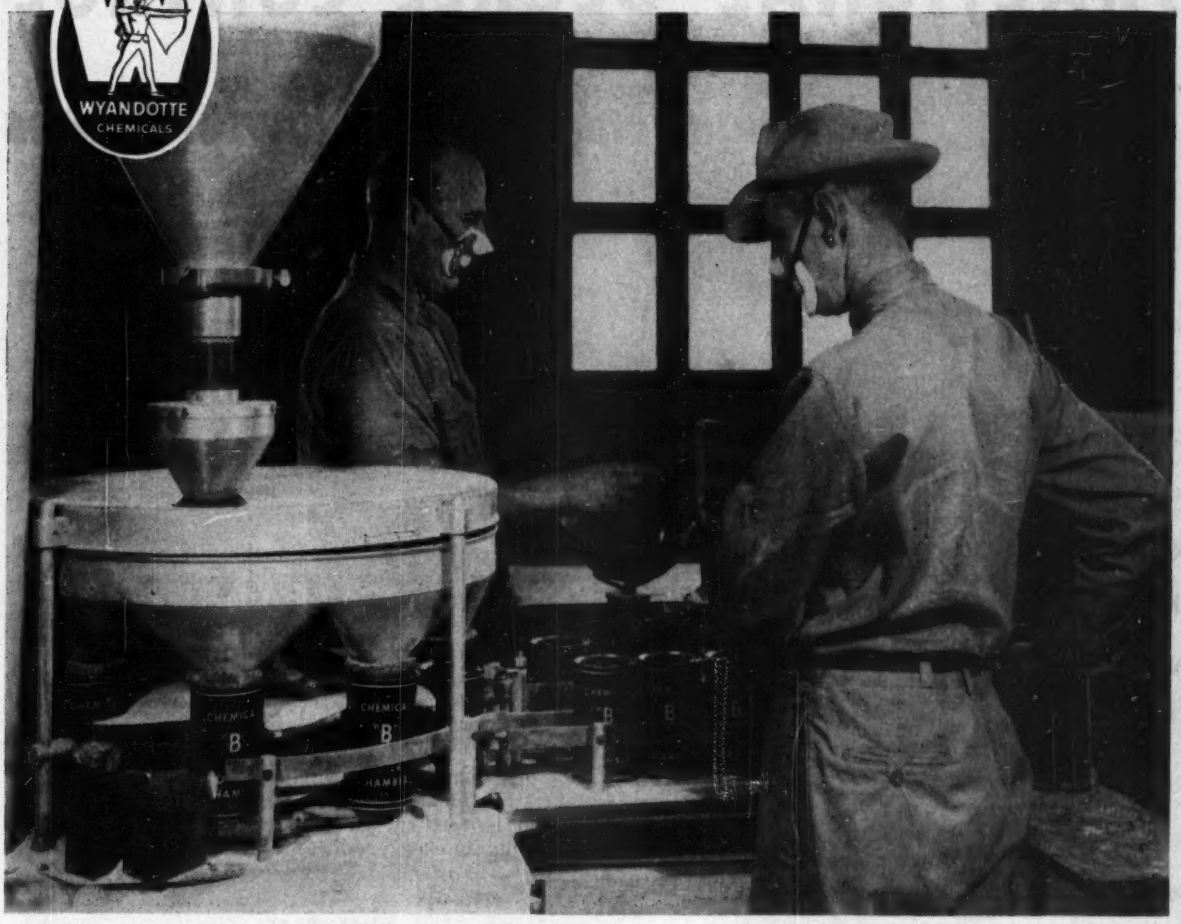
. . . the same lubricant that adds to valve tightness, acts as a jack to keep the plug ready to turn. Just as they cut costs in nearly every service to which they've been applied, Nordstrom valves and genuine Rockwell lubricants

CUT STORAGE COSTS

Remember, the lowest cost valve is not necessarily the cheapest—
it is the valve which does its job best for the longest time.
Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Nordstrom Valves Another Quality **ROCKWELL** Product

Dependable Source for Chemical Raw Materials



Packaging fire extinguishing powder at plant of National Foam System, Inc.

"for our fire extinguishing powders . . .

We've bought Wyandotte Bicarb for 25 years!"

—A. D. HOLMES, *Purchasing Agent*, National Foam System, Inc.

"Since 1928, we have used millions of pounds of Wyandotte Bicarbonate of Soda in our chemical foam fire extinguishing powder," says A. D. Holmes, purchasing agent of National Foam System, Inc., West Chester, Pa., manufacturers of fire protection equipment and chemicals. "During all this time, we have found this product consistently uniform in particle size and of good quality. These characteristics provide for easy flowing and blending when used as an ingredient in our fire extinguishing powder.

"Wyandotte Technical Service has also always been dependable, which is very important to a company like ours doing a large international business in fire protection products."

Whether you use Bicarbonate of Soda in the production of fire extinguishing powders, foods, sponge rubber, drugs, cosmetics, or other industrial applications, you can depend on Wyandotte. Wyandotte Technical Service will help you, too. Phone or write us. *Wyandotte Chemicals Corp., Wyandotte, Mich. Offices in principal cities.*

Wyandotte

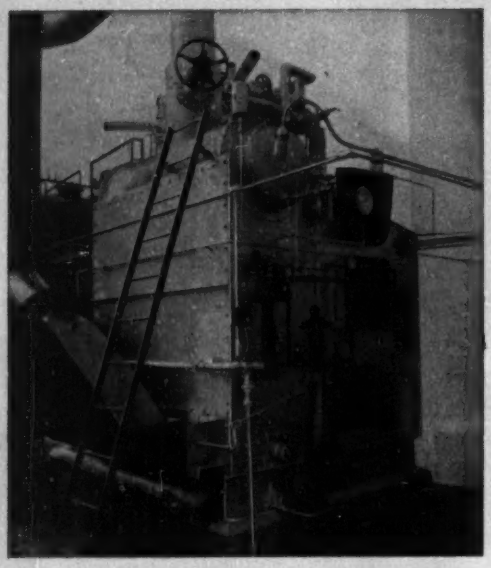
CHEMICALS

HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine
Calcium Carbonate • Calcium Chloride • Glycols • Synthetic Detergents • Agricultural Insecticides • Soil Conditioners
Other Organic and Inorganic Chemicals

FRACTIONAL—DEGREE CONTROL

...at high temperatures, low pressures



FOSTER WHEELER
Dowtherm Systems

From the largest: 45 million Btu/hr, 700F, 88 psi
To the smallest: 50 thousand Btu/hr, 650F, 53 psi

In FW indirect low-pressure Dowtherm Systems, process companies have found a simple, economical answer to critical heating problems.

By permitting fractional-degree temperature control, even during rapid process fluctuations, FW Dowtherm helps eliminate both ruined batches and reruns due to uneven temperatures. It simplifies processing—and yields worthwhile savings in time, materials and equipment.

Foster Wheeler designed, engineered and constructed the first complete Dowtherm heat process system 20 years ago. Since then, FW units have helped more and more plants improve product quality, and reduce operating costs. *Foster Wheeler Corp, 165 Broadway, New York 6, New York.*

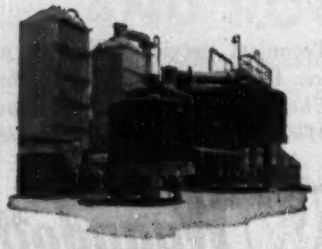
SOME OF THE PROCESSES NOW SERVED BY FW DOWTHERM VAPORIZERS

- Catalyst Heating and Regeneration
- Edible Oil Deodorization
- Esterification
- Fatty Acid Processing
- Oil Bodying
- Phthalic Anhydride Distillation
- Synthetic Resin Manufacturing
- Synthetic Fibre Manufacturing

ADVANTAGES

High temperature processing at low pressure
Fractional-degree temperature control
Uniform temperature throughout processing
Low maintenance and repairs
Simplicity of operation

MEETING THE EXACTING NEEDS OF THE PROCESS INDUSTRIES



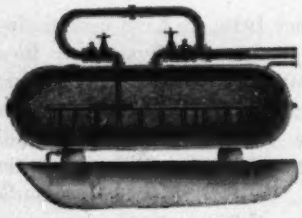
SULFUR RECOVERY EQUIPMENT

Converts H_2S and CS_2 from waste gases into income-producing gases.



WASTE HEAT BOILERS

Help achieve maximum fuel economy and effective temperature control in chemical, oil, paper, metal and many other industries.



STEAM ACCUMULATORS

Automatically store steam to meet peak demands of process plants. Permit operation of boilers at constant, most economical rate.

FOSTER WHEELER



For high-pressure, high-temperature service (as well as sub-zero duty), Chapman makes steel valves in a range of series from 150 to 2500 lb . . . in gate, globe, angle and check types . . . in steels of many different analyses and with suitable trim to resist corrosion and erosion.

Chapman Steel Valves are accurately machined and finished, designed to ASA and API ratings, and may be furnished with flanged or welding ends. These valves can be equipped for any type of operation . . . hand, gearing, hydraulic cylinder or Chapman motor unit as shown in illustration. So for all standard and any special Steel Valves, check with Chapman *first*. Meanwhile, write for Catalog 20.

THE CHAPMAN VALVE MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

How Mississippi Chemical



They did

Mississippi Chemical had a series of *over-all* electrical problems when they were planning this plant.

what

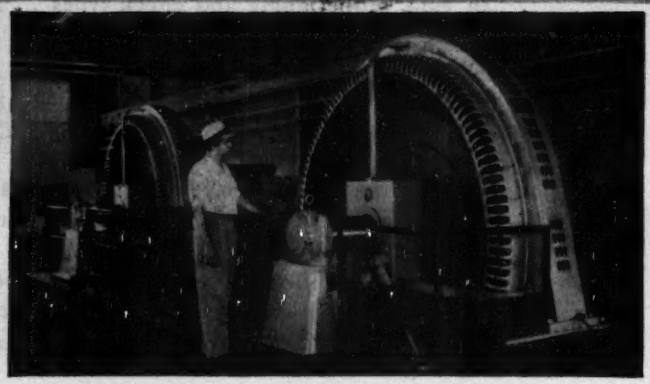
They had Girdler and Westinghouse Engineers *attack these problems as a whole.* Based on previous experience they put togethar a *co-ordinated electrical system.*

you can do

This experience and this over-all method can be applied to your next project, whatever it is. Westinghouse can work with you on *all* your electrical needs.

to produce more

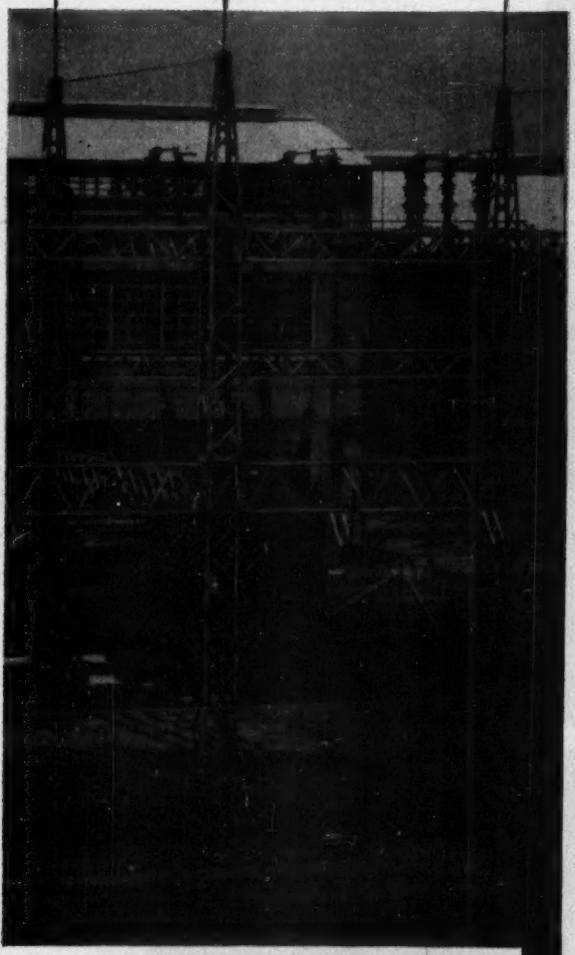
The result will be more dependable production . . . lower costs . . . better operations. Whether you need one motor, or a complex electrical system, call in Westinghouse.



Ammonia Superintendent inspects the 900-hp hyper compressor in the ammonia compressor room. Driving this compressor and all the other drives in the plant are Westinghouse Motors. These motors have a lower installed cost . . . are easier to operate . . . and require less maintenance than other types of drives.

got the BEST power equipment . . .

at no EXTRA cost!



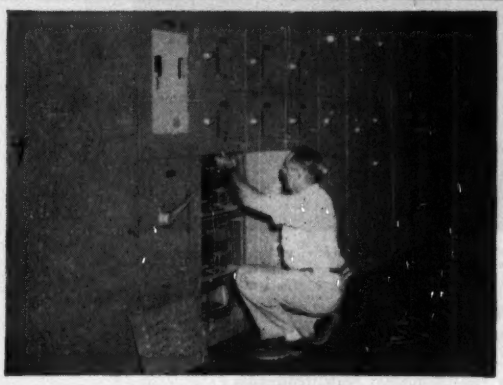
Mississippi Chemical Company recently built a new plant in Yazoo City, Mississippi. For the electrical engineering, Westinghouse and the Girdler Corp., the engineers and prime contractors, put their heads together. By careful planning they developed a power system that uses the best type of modern equipment *but at no extra cost.* They made savings that offset the higher price. Here's how they did it.

Dependable, Low-Cost Power. To make use of the low-cost power available from the Mississippi Power and Light Company, a complete Westinghouse Substation was installed. Included were two 6000/7500-kva transformers. This rating permits line-starting of the large compressor motors and eliminates the need for costly special controls. The best secondary voltage was determined to be 2400/4160Y-volts. This reduces the size of the copper wire . . . keeps line losses at a minimum . . . and can be easily handled by standard transformers.

Top Motor Performance and Protection. For the main compressor drive, they chose electric motors because they have a lower installed cost . . . are easier to operate . . . and require less maintenance than other drives. The motor control centers were installed throughout the plant in non-hazardous locations. They got the advantage of grouped control without using more expensive, explosion-proof equipment.

Emergency Power Assured. For insurance purposes, an immediate source of stand-by power was required. Neither a combustion engine nor a condensing turbine met the requirements of fast, easy operation. However, a Westinghouse Type E turbine did the trick. It could be started by one man . . . reach full operation in 20 seconds . . . and it costs 25 percent less than any other adequate unit.

Westinghouse Can Help You. The next time you plan to build or expand your plant, call in Westinghouse. You can get these same benefits . . . the results of accurate system planning and dependable Westinghouse equipment. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-94902



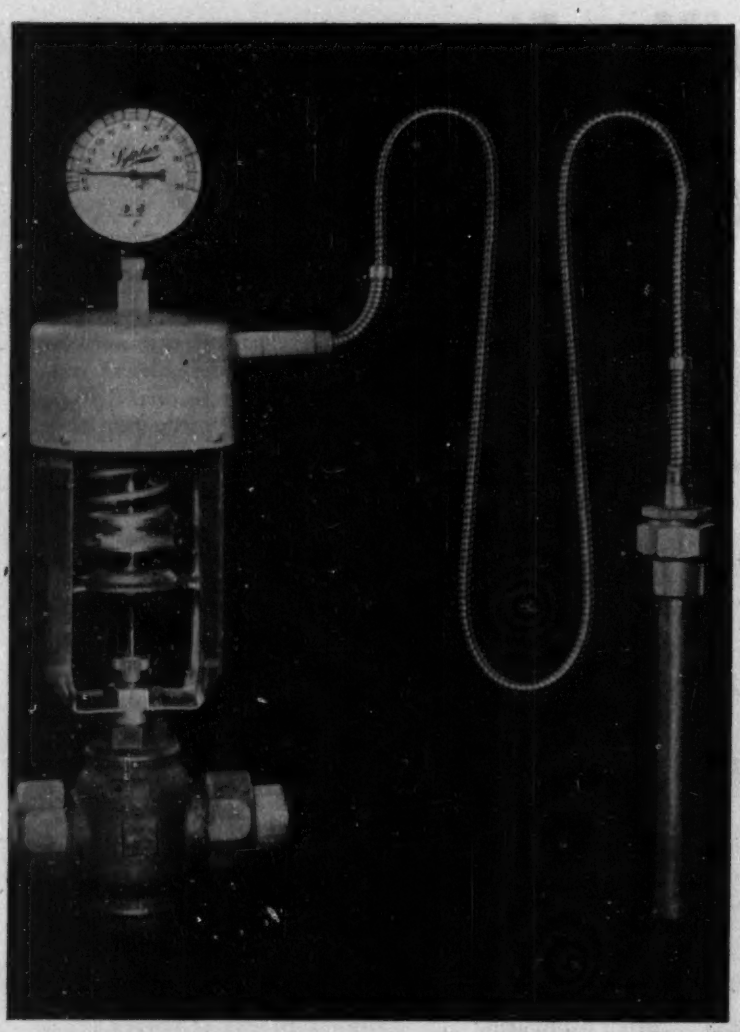
Shown here is a Westinghouse Power and Control Center which supplies the power for the motors in the ammonia plant. These power and control centers are installed throughout the plant in nonhazardous locations to take advantage of grouped control.

YOU CAN BE SURE . . . IF IT'S

Westinghouse

ELECTRICAL EQUIPMENT
FOR THE CHEMICAL INDUSTRY

WESTINGHOUSE



News about flexible metal hose and tubing

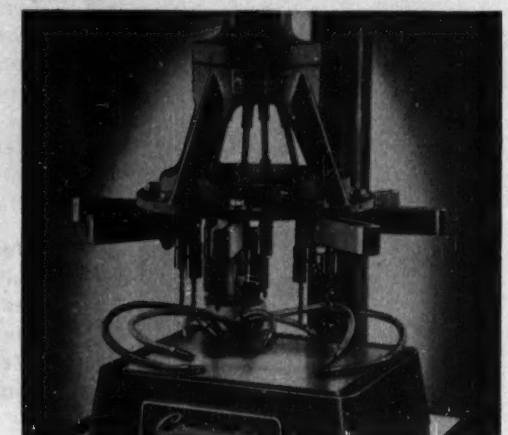
3 versatile applications of interest to design, production and maintenance engineers

PROTECTS DELICATE TUBING – Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville, Tenn. uses 7/32 in. and 23/64 in. I.D. American Flexible Brass Hose in this Temperature Regulator. This hose takes sharp bends and installs economically. To protect wiring or flexible shafts, connect moving lines or make assemblies in cramped spaces—design with American Flexible Metal Hose.



CONVEYS STEAM – Tire molds need steam – lots of it. At Bacon Vulcanizer Manufacturing Co., Oakland, Calif. American Seamless Flexible Bronze Tubing flexes safely and easily with every opening of the mold. Pressure changes or extreme hot-to-cold temperatures won't swell or collapse it. American has a seamless flexible metal tubing to meet your production requirements for a connector that must move, bend, vibrate or resist heat, cold or pressure.

WRITE FOR BOOKLET CC-400: *shows how the tubing is designed, used and installed – gives specifications on tubing and fittings. The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Co., Ltd.*



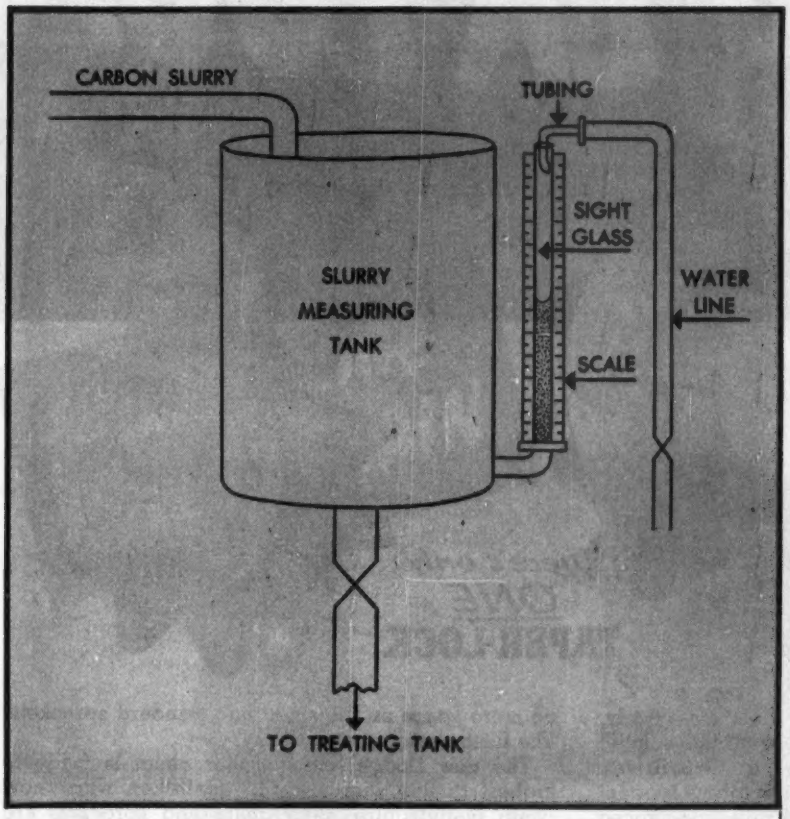
DIRECTS COOLANT FLOW – With this Commander Coolant Table (Commander Mfg. Co., Chicago, Ill.), you can quickly position 8 coolant streams. American Flexible Steel Hose "stays put." Consider this hose both for easily-assembled products and for maintenance requirements.

wherever connectors must move... American flexible metal hose and tubing

DARCO Digest

DARCO DEPARTMENT • ATLAS POWDER COMPANY
Darco General Sales Offices—60 EAST 42nd STREET, NEW YORK 17, N. Y.
ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

SLURRY MEASURING TANK FACILITATES ACCURATE MEASUREMENT OF DARCO DOSAGE



Accurate measurement of the dosage of Darco activated carbon helps you get the most out of your purification process.

The simple equipment diagrammed here provides a convenient means of metering the volume of Darco slurry supplied to a batch treatment process. All you need is a measuring tank big enough to hold the peak dosage you plan to handle, plus a calibrated sight glass with a water flush line connected as shown.

The carbon slurry is fed from the slurry preparation tank into the measuring tank. When the sight glass indicates the desired volume of slurry, the measured amount is then dumped into the treating tank.

After each measurement, the flush valve is opened briefly, to allow a small volume of water to wash any deposited carbon from the inside of the sight glass. The glass is then clear for the next time it is needed for measurement.

DARCO reduces loss of oil in filter cake

Whenever activated carbon is used for removing undesirable odor and color from vegetable, marine and animal oils, some of the oil always stays in the filter cake. This retained oil can represent a loss, but it can be minimized.

Darco retains much less oil than most other activated carbons. For each 100 pounds of Darco, the increase in yield can amount to 60 to 90 pounds more oil out of the filter.

Through decreasing oil retention loss, Darco can actually pay for itself. And at the same time, it does an excellent job of adsorbing contaminants from the oil.

How to remove trace metals from water-immiscible liquids

When plasticizers and other liquids that do not mix with water contain undesirable metallic impurities, ordinary filtration techniques often won't purify adequately. Here's a method that has proved successful in some problems of this type.

In one example, a small amount of water was added to the liquid to be purified. It was agitated thoroughly to disperse the water throughout, and then the excess water was removed. The liquid was next treated with about 1 per cent of Darco G-60—a highly activated, premium-purity grade activated carbon.

In this instance, the trace metal was transferred to the water phase . . . from which it was adsorbed by the Darco. At the same time, the haze of emulsified water was adsorbed by the Darco, too—leaving the original liquid clear and free of contaminants.



—and now TAPER-LOCK



There's only ***ONE*** **TAPER-LOCK**

FROM the package to the shaft — ready, *immediately,* for the job! This is the new "off-the-shelf" availability which Dodge brings to roller chain drives. And, with this new availability, you get the important advantages of the famous Taper-Lock principle, proved in millions of V-belt installations.

No more costly and time-consuming boring of sprockets to fit your shafts! *Taper-Lock bushings are available in a range of sizes for the great majority of industrial applications.* And it's not necessary that shafts be turned and ground to get a tight fit. *Taper-Lock not only is keyed to the shaft, but grips it with the firmness of a shrunk-on fit.* Yet when a sprocket is to be replaced, it comes off easily, quickly. The bushing may be re-used.

Taper-Lock sprockets are compact. They have no flange, and no protruding parts. Taper-Lock occupies no more space on the shaft than standard sprockets. The flush design means safety.

The new Dodge line of roller chain is made to highest quality standards, by craftsmen who know chain manufacture. Both chain and sprockets are made to ASA standards. Taper-Lock sprockets will take any make of American standard chain.

Taper-Lock sprockets will be carried in Distributors' stocks for immediate delivery, in a complete range of B-type steel sprockets—½" to 1¼" pitch. The range in ⅝" pitch, for example, is 12 to 112 teeth.

All bushings and the smaller sizes of sprockets are packaged individually. Dodge roller chain is packaged in 10-foot lengths — and can be furnished in 50-foot and 100-foot reels.

For detailed information about Taper-Lock sprockets and Dodge chain drives write now for Bulletin A-624.

DODGE MANUFACTURING CORPORATION, 200 Union St., Mishawaka, Indiana

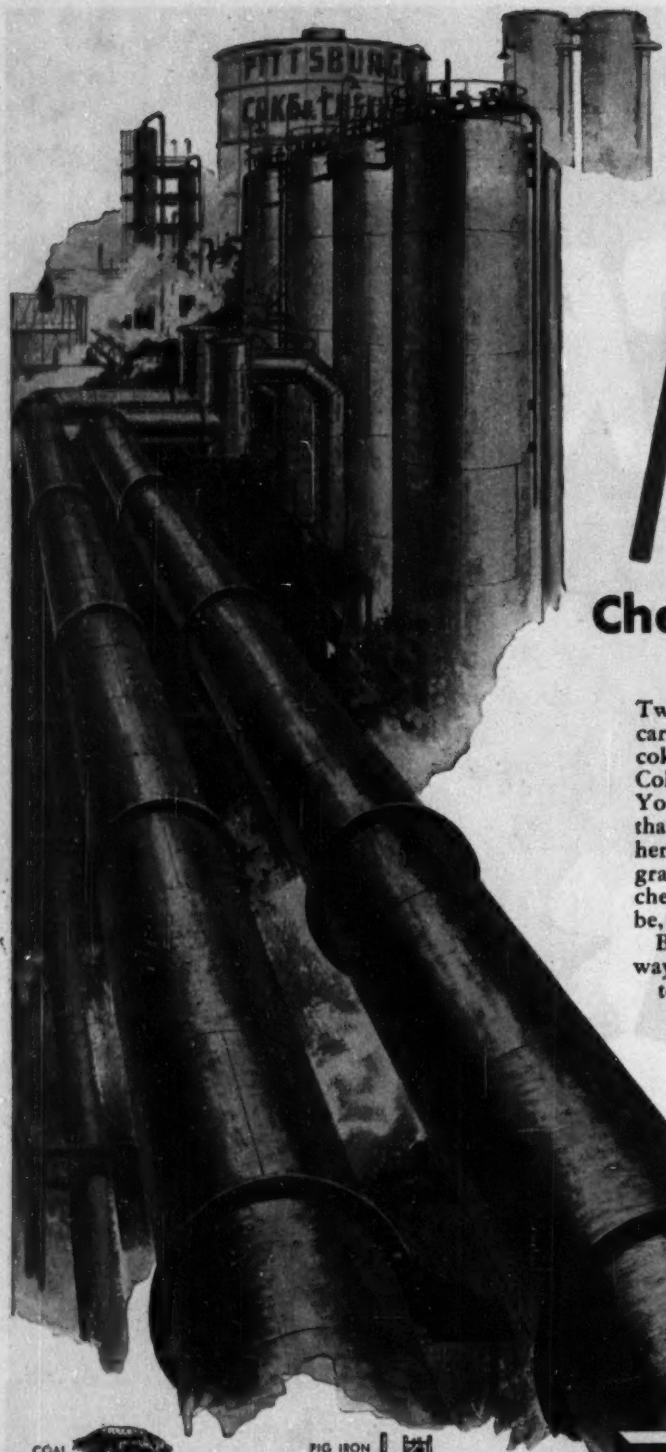
SPROCKETS

-and DODGE ROLLER CHAIN



CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory-trained by Dodge, he can give you news of cost-saving methods. Look for his name under "Power Transmission Equipment" in your classified phone book.

DODGE



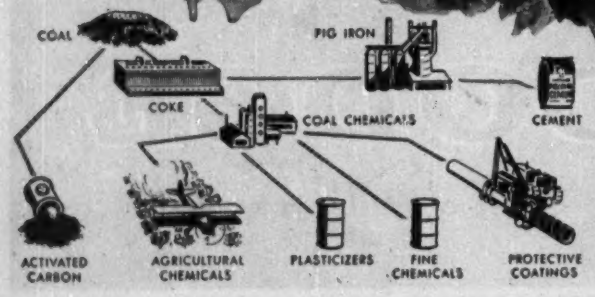
Main Line to New Chemical Wonderlands

Twenty-four hours a day, these giant steel pipes carry a rich cargo of chemical-laden gases from coke ovens to chemical plants of the Pittsburgh Coke & Chemical Company. Final destination? Your new crease-proof summer suit, the drug that takes the sneeze out of your hay fever, the herbicide that kills your weeds but not your grass . . . and perhaps 100,000 other coal chemical-made products that are, or soon will be, an important part of your life.

But there's an important "line" going the *other* way from our coke ovens, too. It carries coke to our blast furnaces for pig iron production. And slag from these furnaces is made into cement for highways and homes.

Diversified production? Yes, but completely integrated, too. For the operations of Pittsburgh's ten divisions are welded into a single, *basic* production pattern. The manufacturing efficiencies and coal-to-product quality control that result have made the Pittsburgh Coke & Chemical Company trademark a hallmark of dependability.

W&D 4644



PCC

PITTSBURGH
COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

Here's how this strainer "combs" itself clean!

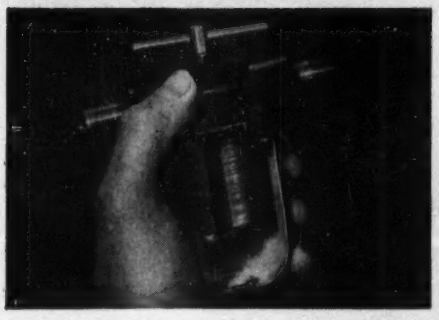
This simple chalk test shows how AUTO-KLEAN's unique built-in comb construction cleans the strainer without costly interruption of flow



ORDINARY BLACKBOARD CHALK leaves heavy deposit of chalk particles on and between discs of Cuno AUTO-KLEAN strainer.



TURNING HANDLE ONE REVOLUTION moves strainer element through comb blades, removing all traces of chalk from between discs. Cuno's exclusive combing operation cleans *thoroughly* —without stopping flow.



FILTERING AREA IS COMPLETELY CLEAN, restoring full initial capacity. All chalk particles and dirt fall to bottom of housing where they can be drained periodically.

- AUTO-KLEAN's permanent metal filter element is available in steel, brass, or stainless steel for long, trouble-free service.
- AUTO-KLEAN is adaptable to any fluid-flow system.
- From acids to tar . . . if you can pump it, Cuno can filter it. Capacities range from one gallon per hour to 15,000 gallons per minute.

CUNO ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

AUTO-KLEAN'S "NON-STOP" FLUID FILTRATION STEPS UP PRODUCTION IN CHEMICAL PLANTS

There's no need to shut down to clean this strainer!

The Cuno AUTO-KLEAN is the only fluid cleaner on the market that operates continuously—without requiring costly interruptions in flow and service. Cuno's exclusive "comb-clean" action allows *complete* cleaning of the filter element without stopping fluid flow.

Thus, no loss of production, no chance of contaminating the product by exposure while cleaning or replacing an element.

AUTO-KLEAN's low pressure drop permits *full-flow* operation on gravity, low pressure, or suction lines—with no loss in operating efficiency. AUTO-KLEAN's compact construction provides this full-flow fluid protection in space which would limit ordinary filters to by-pass service.

The low maintenance costs of the AUTO-KLEAN save you money, for there are no cartridges to change. An occasional rotation of the handle does a thorough cleaning job (most units can be equipped with motor-drives for continuous cleaning).

Fixed-space metal discs in this modern strainer positively remove all solids larger than the specified disc spacing—from .0035" up to .062".

Find out now about Cuno's AUTO-KLEAN—the precision-built strainer.

A.3.2

Cuno Engineering Corporation
Dept. 102A, South Vine Street, Meriden, Conn.

Please send information on Cuno AUTO-KLEAN for .....
(fluid)

Name.....

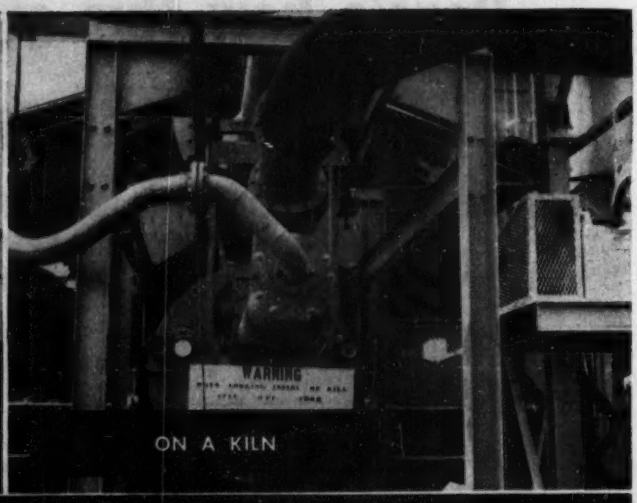
Company.....

Address.....

City.....Zone....State.....



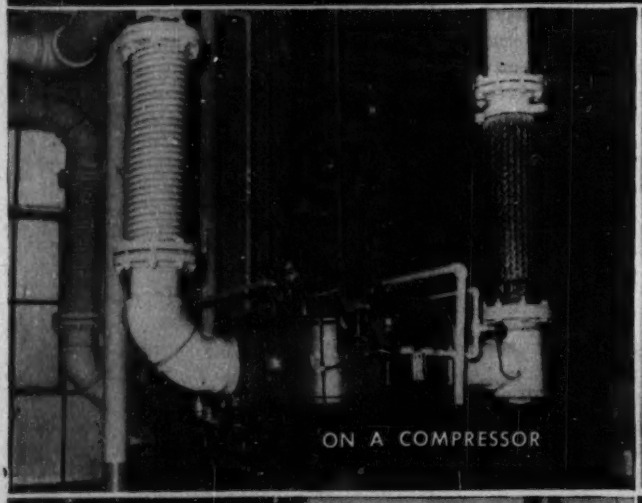
LOADING AND UNLOADING



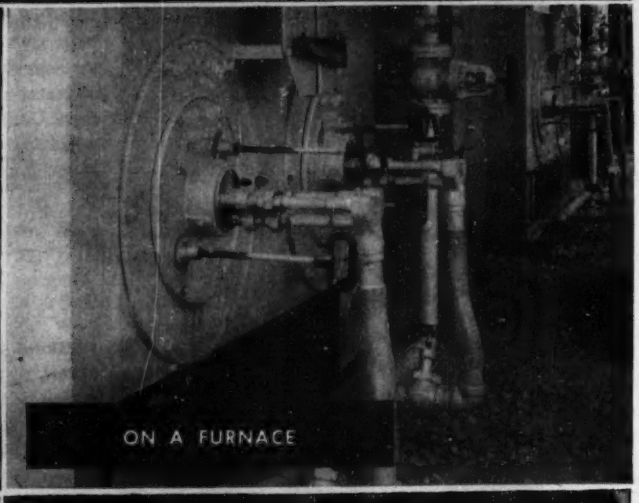
ON A KILN

Wherever vibration, flexation, misalignment or

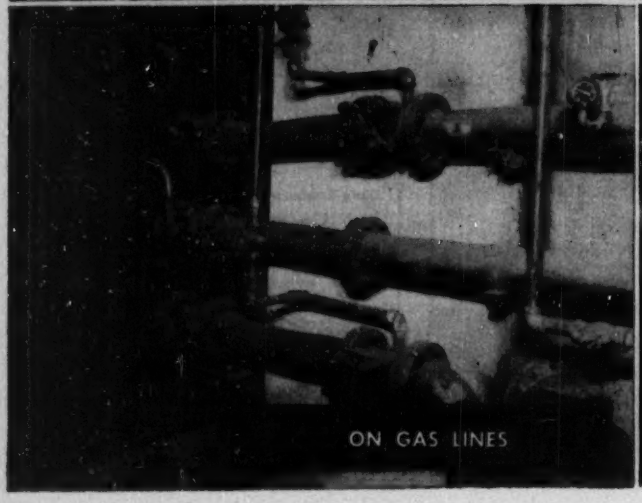
make the connection with CMH



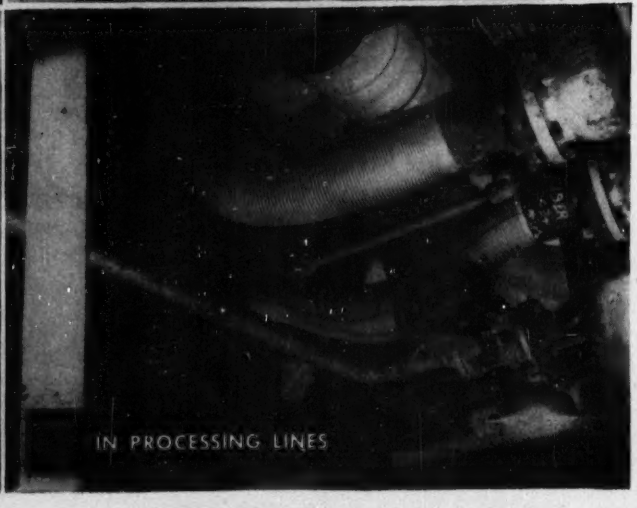
ON A COMPRESSOR



ON A FURNACE



ON GAS LINES



IN PROCESSING LINES

■ CMH Flexible Metal Hose, properly used, can save many times its cost by eliminating piping failure due to motion and fatigue stress . . . by simplifying installation . . . by reducing the number of fittings required . . . by minimizing downtime required for piping maintenance. In CMH flexible metal hose, you get the rugged durability of metal combined with a high degree of flexibility. You get a non-aging, non-contaminating, non-collapsible assembly with no joints to pack, assuring a long, dependable, maintenance-free life.

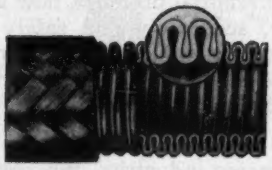
In the CMH complete line of flexible metal hose products there is the exact type to meet your needs. Pressures from vacuum to 24,000 psi (burst) can be accommodated. A wide variety of metals is offered, too, to provide hose types which are corrosion resistant, fire resistant and capable of handling extremely searching liquids and gases.

Whenever, a connection problem involves vibration, flexation, misalignment or expansion and contraction, think first of CMH flexible metal hose for an economical, dependable and safe solution. Your Flexonics distributor will be pleased to go over your requirements with you. Look for his name in the classified pages of your telephone directory or write and we will send it.

expansion and contraction is a problem.....

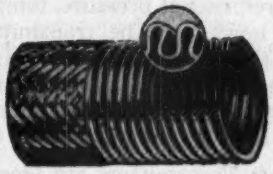
FLEXIBLE METAL HOSE

REX-WELD HOSE



CMH REX-WELD corrugated steel hose in sizes from 3/16" through 24" I.D. for burst pressures to 12,000 psi, temperatures to 1000°F. Also available in bronze.

REX-FLEX HOSE



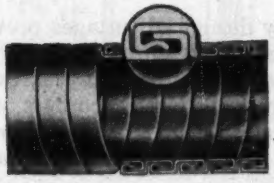
CMH REX-FLEX corrugated stainless steel hose in sizes from 5/16" through 2" I.D. for burst pressures to 24,000 psi, temperatures to 1600°F.

REX-TUBE TYPE RT-6



CMH REX-TUBE Type RT-6 fully interlocked flexible tubing in galvanized steel, aluminum, brass and other metals; sizes ½" through 8" I.D.

REX-TUBE TYPE RT-15



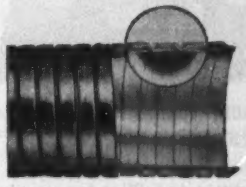
CMH REX-TUBE Type RT-15 fully interlocked steel or bronze utility hose in sizes from ½" to 12" I.D. for pressures to 750 psi. (constant), temperatures to 600°F.

REX-TUBE TYPE RT-20



CMH REX-TUBE Type RT-20 steel or bronze ball bearing type utility hose in sizes from 3/16" through 1¼" I.D. for low to moderate pressures and temperatures.

ABRASION RESISTANT HOSE



CMH "Abrasion Resistant" hose Type AR-1, fully interlocked with strip inner liner for handling grain, forage, ashes and other dry solids, 1½" to 12" I.D.

Catalog 130 gives specifications and application data on CMH flexible metal hose. Write for your copy or see Flexonics catalogs in Sweet's, Chemical Engineering Catalog or The Refinery Catalog.

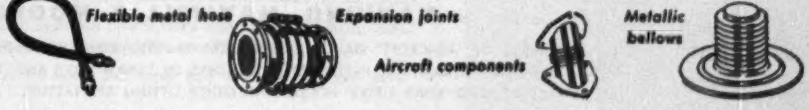
Flexon identifies CMH products that have served industry for over 50 years.

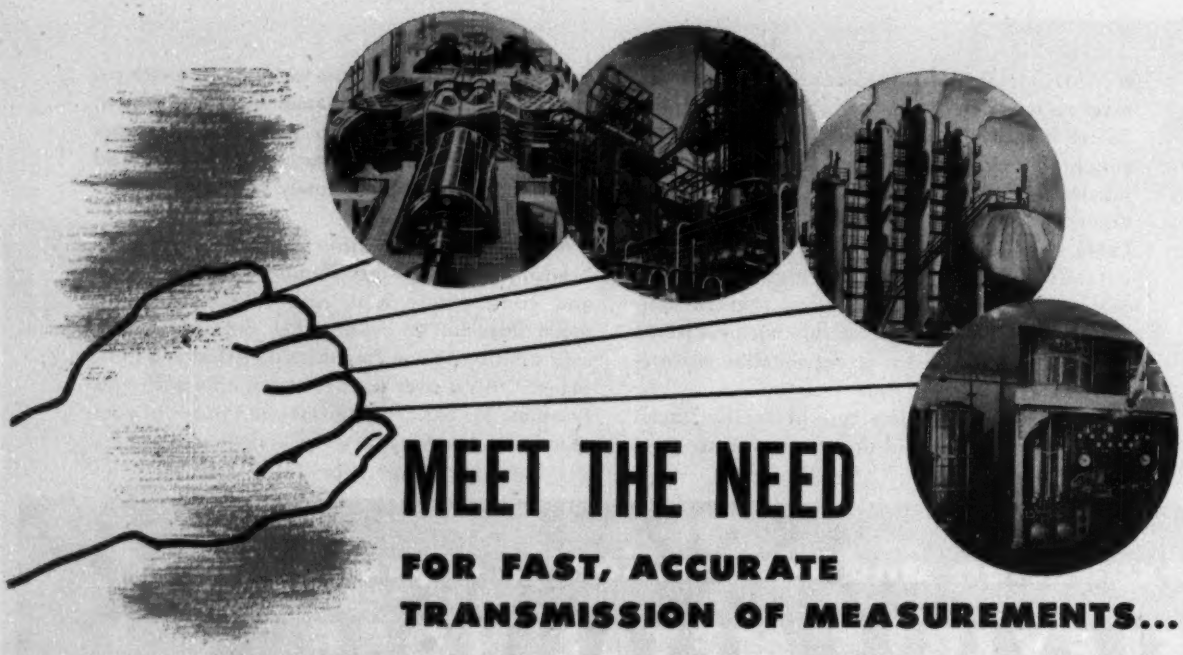
CMH

CHICAGO METAL HOSE Division

Flexonics Corporation 1317 South Third Avenue, Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

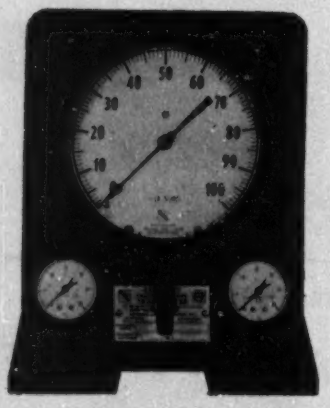




MEET THE NEED

FOR FAST, ACCURATE TRANSMISSION OF MEASUREMENTS...

ASHCROFT PNEUMATIC TRANSMITTERS



ASHCROFT PNEUMATIC PRESSURE TRANSMITTER with two 2-inch gauges, one reading "Air Supply," the other "Transmitted Air." Other types available for temperature, differential pressure, flow and liquid level.

Measurements of pressure, temperature, differential pressure, flow and liquid level must be transmitted quickly, accurately and safely to assure the efficiency required by modern process engineering. Ashcroft Pneumatic Transmitters more than fill those requirements—contribute greatly to the perfect performance demanded of vital instrumentation at one or more remote control centers.

Ashcroft Transmitters are ideal for all process industries and power stations—wherever it is desirable to confine high pressures or inflammable, poisonous or corrosive liquids and gases close to their source. They are also highly suitable where fire or explosion hazards make electrical wiring objectionable, or where the existing source of compressed air can easily be used.

Built into Ashcroft Transmitters are many design advantages proved through years of experience in manufacturing pressure gauges. They operate on low-pressure air—transmit proportionate air pressures to one or more pressure-actuated receiving indicators, recorders and controllers up to 1000 feet away with accuracy within ½ or 1%. Expensive, high-pressure lines and fittings, with all their leakage and maintenance problems, are avoided.

Write for details about Ashcroft Pneumatic Transmitters. Or ask your nearby Instrument Distributor for complete data on all types.

YOUR INSTRUMENT DISTRIBUTOR carries Manning, Maxwell & Moore products because he wants to be sure you get the best in quality, performance and economy. You can depend on him for prompt service.

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

SCHUTTE and KOERTING Company

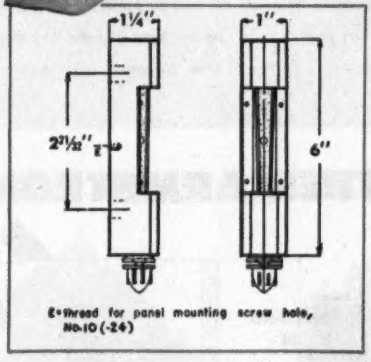
SK Engineering News

New, Inexpensive SK Purge Rotameters* Indicate and Permit Manual Control of Fluid Flow in Small Quantities

***featuring a back flow check valve and flow control valve**



$13.00 each, net consumer, F. O. B., Cornwells Heights, Bucks County, Pa. In ordering, always state Fig. No., Meter Size, and Scale Marking.



E=Thread for panel mounting screw hole, No.10 (-24)

Here's a really new type Rotameter—the SK Fig. 1846CV Purge Rotameter. It's small (weighs ½ lb.) and inexpensive, yet particularly well designed and sturdily constructed with a one-piece body. It is ideal for use in indicating and manually controlling fluid flow in low flow ranges where good reproducibility but only moderate actual metering accuracy are required.

With this small, variable area type flow meter, the rate of flow of fluid passing through the meter is indicated by the position of a ball float moving in a tapered glass meter tube. The rate of flow is read in reference to the center of the ball float on a scale mounted alongside of the meter tube.

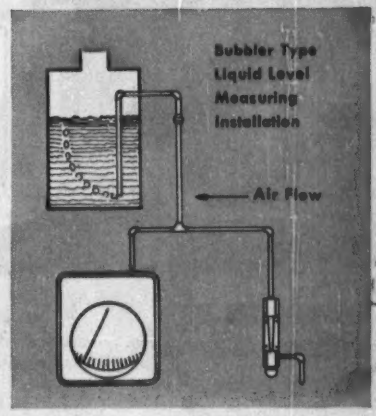
Typical applications include the indication of—

. . . flow of supply air in Bubbler Type Liquid Level Measuring Installations, see drawing.

. . . flow of purge fluid, generally water or air, in the pipelines connecting orifices, venturi tubes, or nozzles to differential head flow meters.

. . . flow of transparent purge fluid to sight glass indicators of Rotameters measuring the flow of opaque fluids.

. . . flow of purge fluid to indicator extensions of indicating Rotameters or to extension wells of Rotameters with electric or pneumatic transmitters where the process fluid carries slurries, tends to settle out crystals, or may form surface coatings.



. . . flow of sample fluid to measuring installations for continuous analysis of fluids.

Special features of the Purge Rotameter include—

. . . a Back Flow Check Valve to positively prevent back flow of process fluid.

. . . a Flow Control Valve for providing sensitive control of fluid flow through the meter over the entire flow range of the meter at differential pressures between 1 to 100 psi across the control valve.

. . . a rigid one-piece meter body which will withstand rough handling in pipe installations and effectively protect the glass tube.

. . . a design particularly suitable for installing directly in pipelines or mounting on instrument panels or in larger instrument cases.

Price, as noted is $13.00 each, net consumer, F.O.B., Cornwells Heights, Bucks County, Pa. Order now.

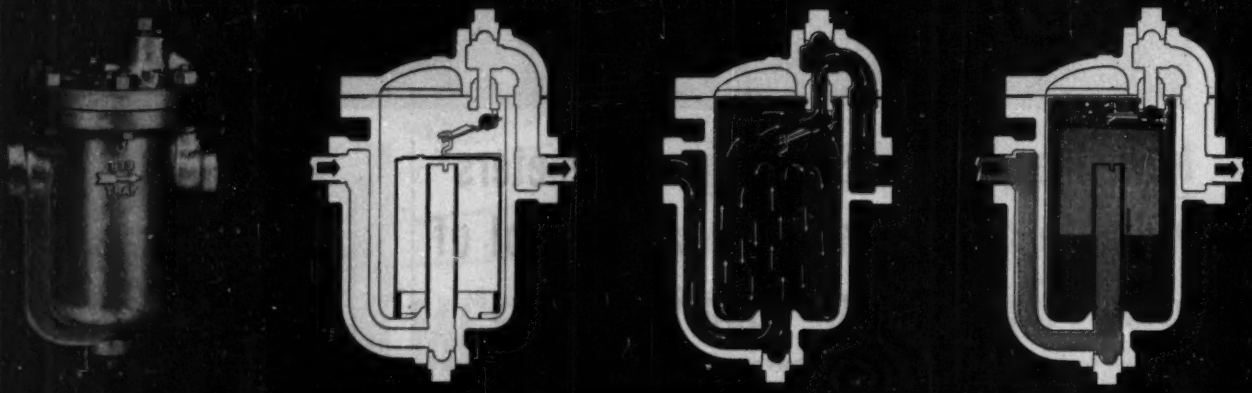
Meter		Flow Conn.	Rotor Type	Flow Ranges		Pressure Drop	Scale Marking
Type	Size			Water at 70° F	Air at 10 psig & 70° F		
Fig. No.	No.	Inches	No.	gph	cfh	psi	
1846CV	03RZ	⅛ NPT	RB033		.2—2	.8—1	.2—2
	01RZ		RB010	.4—4		1.3—1.5	.4—4
	1RZD		RB10	.1—1* 1—8	.1—2* 2—30	1.5—2	0—10

Note: *Meter and valve bodies are made of anodized aluminum. Control valve shaft is made of stainless steel. Maximum Operating Temperature is 200° F. Maximum Operating Pressure is 200 psig.*

**The low and high flow ranges are obtained in the lower and upper half of the double taper meter tube respectively.*



ARMSTRONG TRAPS are



A WORKING PICTURE OF ARMSTRONG DESIGN

1. When trap is first installed, the inverted bucket is down and the valve is wide open.

2. When steam is turned on, condensate (cooler) flows into trap and out through discharge orifice, until . . .

3. steam (light color) reaching the trap floats the inverted bucket and closes the valve.

THE highly efficient design of modern Armstrong traps directly reflects over 40 years' experience in inverted bucket trap manufacture and application gained since Armstrong developed the first practical inverted bucket trap in 1911.

Armstrong design offers:

- A "frictionless" leverage system which combines high leverage with wide opening of a large orifice.
- A minimum of parts.
- Strong, corrosion-resistant and wear-resistant materials.
- Generous margins of safety.

For trap users this means:

- Large capacity.
- Dependable service under adverse operating conditions.
- Low maintenance.
- Continuous operation of heating and process equipment.

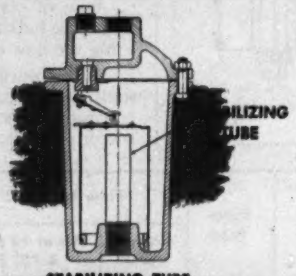
The soundness and benefits of Armstrong design have been proved in thousands and thousands of plants all over the world. To insure dependable condensate drainage for a new plant or plant expansion, simply specify: "Traps shall be Armstrong." For additional information, call your local Armstrong Representative or write:

ARMSTRONG MACHINE WORKS
858 Maple St., Three Rivers, Michigan

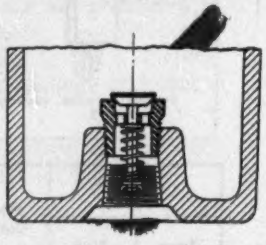
SELF-SCRUBBING ACTION (see Fig. 2 above). Note that condensate first flows down *between bottom of bucket and trap body*, then up and out through orifice. The high velocity flow under bottom of bucket keeps dirt in suspension, washes it out when trap opens. No dirt problems with Armstrong design.

BUCKET FLOATS WHEN LESS THAN ½ FULL OF STEAM (see Fig. 3 above). The generous margin of safety (dimension A in Fig. 3 above) insures that the bucket will float with trap body partly full of water. A heavier bucket would give more power but it might not float and close the valve.

SOME OTHER ARMSTRONG



STABILIZING TUBE
Condensate, air and steam are admitted above water level in trap bucket. The water level is undisturbed, eliminating wear-producing agitation of the bucket, valve lever and valve. This exclusive feature greatly lengthens life of working parts.

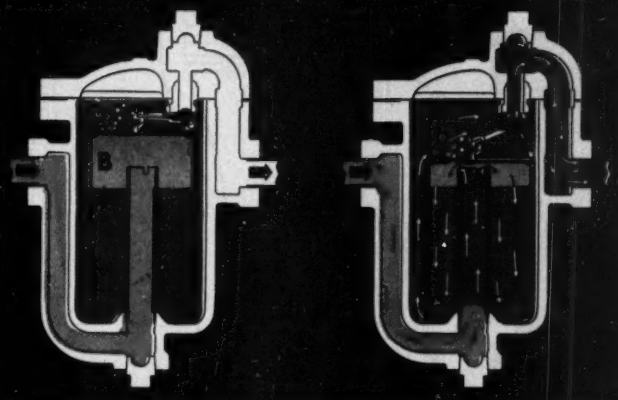


INTERNAL CHECK VALVE
All Armstrong traps can be equipped with the Armstrong spring-loaded stainless steel check valve. Costing less than an external check valve, it also saves installation labor and fittings.

ARMSTRONG · INVERTED BUCKET STEAM TRAP

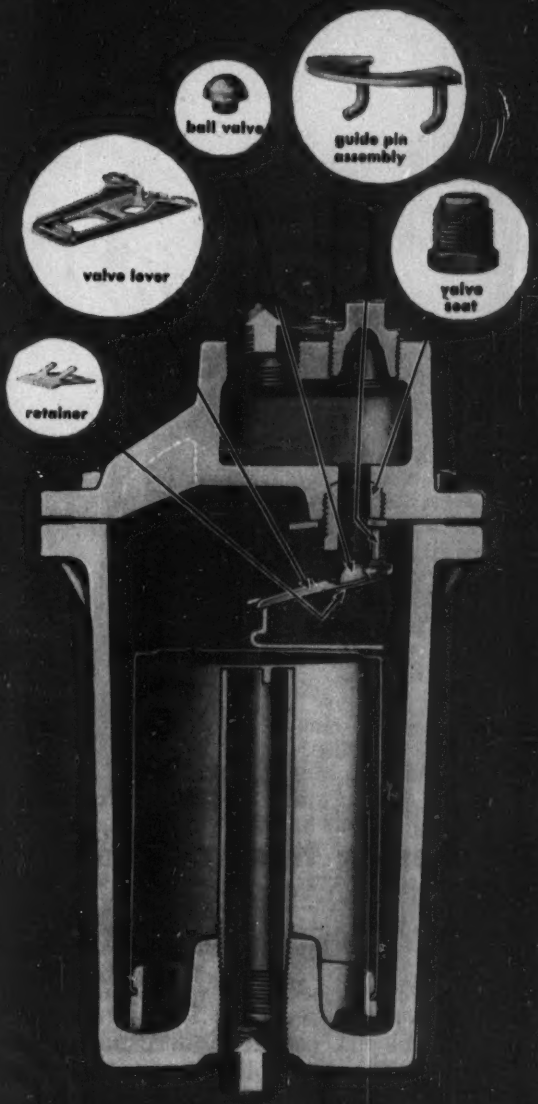
ARMSTRONG

Designed to give be



4. When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

5. When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.



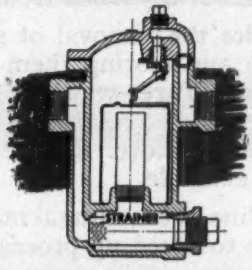
NO AIR BINDING (see Fig. 4 above). Air mixed with steam passes through the bucket vent, collects at top of trap and is discharged ahead of condensate. The large air-handling capacity of Armstrong traps insures top equipment temperatures and faster heat-up.

EXCESS POWER PROVIDED FOR OPENING TRAP (see Fig. 5 above). Weight of bucket times leverage opens trap. Here again Armstrong design provides a generous safety margin. Reducing dimension B in Fig. 4 would increase power of bucket but margin between test opening pressure and operating pressure would be too low to allow for normal wear and for pressure fluctuations.

TRAP DESIGN FEATURES



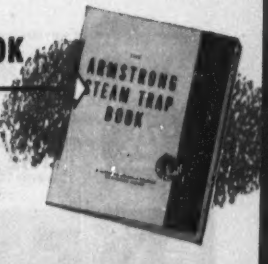
THERMIC VENT — Where large amounts of air must be discharged when steam is turned on, and where air can be pushed out ahead of incoming steam, this bucket will speed heat-up greatly. The vent is open when trap is cold, closes at 210° F. Has 50 to 100 times air handling capacity of standard buckets.



INTEGRAL STRAINER TRAPS — The two smallest sizes of Armstrong traps, most apt to need strainer protection, are available in a body style having the strainer built right in. The strainer can be cleaned while trap is operating.

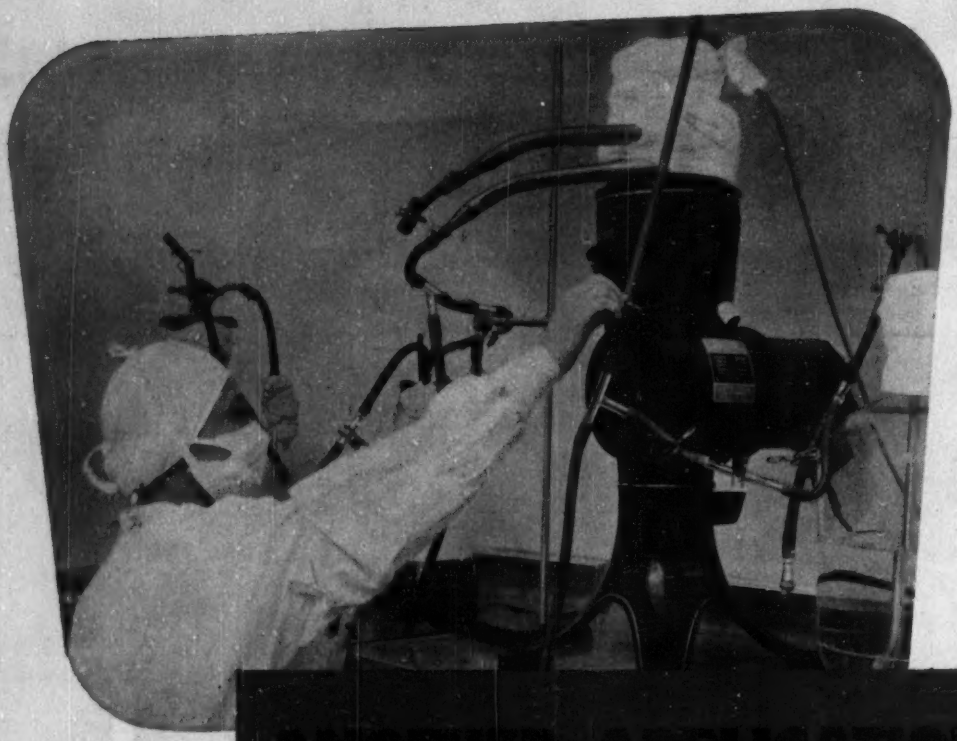
SEND FOR *NEW*

44-PAGE STEAM TRAP BOOK



Complete data on Armstrong trap design and operation; physical data and list prices; capacities; selection, installation and maintenance recommendations. Free on request.

STEAM TRAPS



ANOTHER APPLICATION FOR DE LAVAL CENTRIFUGES!

Processing Human Blood

In processing blood to make plasma, it is important to remove fat cells from the plasma. This is done easily and completely by means of a De Laval centrifuge.

De Laval machines can be used for one-, two-, and three-way separation, usually called clarification because it involves removing a solid from a liquid, such as removing solids from glue liquor.

Two-way separation includes the removal of small quantities of solids (usually less than 0.5%) and storing them in the bowl. The separation of blood is an example. Three-way separation includes the continuous separation of two liquids and simultaneous continuous removal of solids from the liquid mixture. The removal of citrus oil from fruit juice and pulp is an example.

De Laval offers a complete line of centrifugal machines so that you may have exactly the right one to speed up processing in *your* plant.

THE DE LAVAL SEPARATOR COMPANY Chicago POUGHKEEPSIE San Francisco

DE LAVAL for CONTINUOUS Separation with Centrifugals



partners

in **mixing** foods and chemicals

Just as the toothbrush belongs with toothpaste so stainless steel castings by COOPER ALLOY belong wherever mixing equipment for the food, chemical and allied industries is being designed or manufactured. Whether your interest be in small propellers weighing half a pound, or in giant mixers weighing a ton or more, our experience as the foremost producer of corrosion resistant cast products is your guarantee of a profitable and pleasant partnership. To get to know us better, why not fill in the coupon below for your free copy of our new booklet "Thirty Years of Progress." It will give you an inside view of our plant and its facilities and may help to illustrate how our experience and know-how can best serve your needs.

COOPER ALLOY

THE COOPER ALLOY FOUNDRY CO. • HILLSIDE, N. J.

Los Angeles, San Francisco, Oakland, Houston, Chicago, Detroit, Philadelphia, Hartford

Leading producers of STAINLESS STEEL valves, fittings and castings

☐ Please send your new booklet "Thirty Years of Progress"

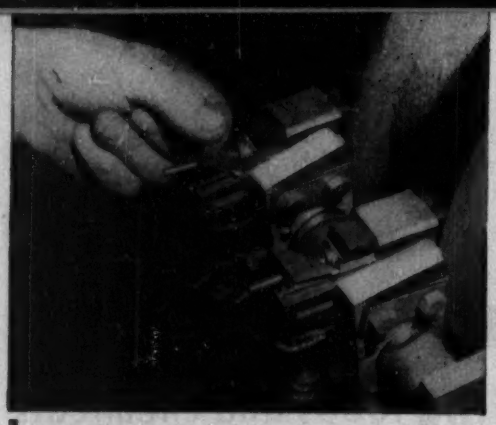
☐ Please have your representative call.

Name_____ Position_____

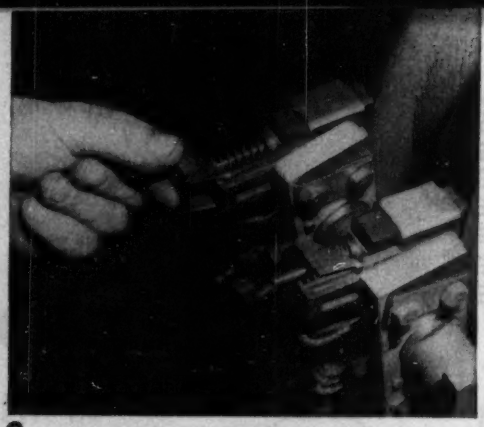
Company_____

Address_____

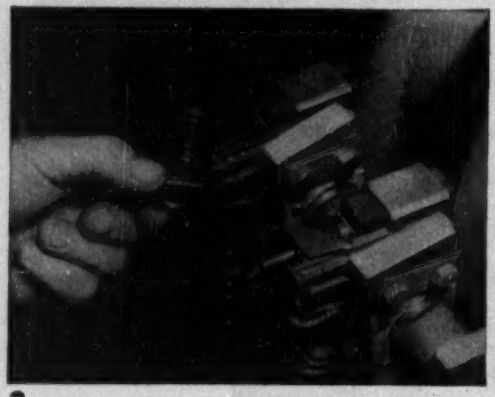
City_____ Zone_____ State_____



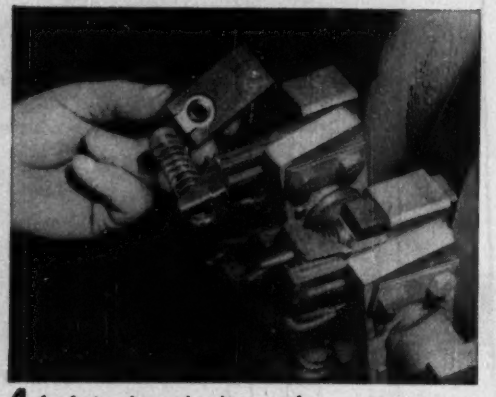
1 To reset brush tension, operator releases spring lock . . .



2 slides it back to relieve pressure . . .



3 and swings locking device to one side . . .



4 for fast and easy brush removal.

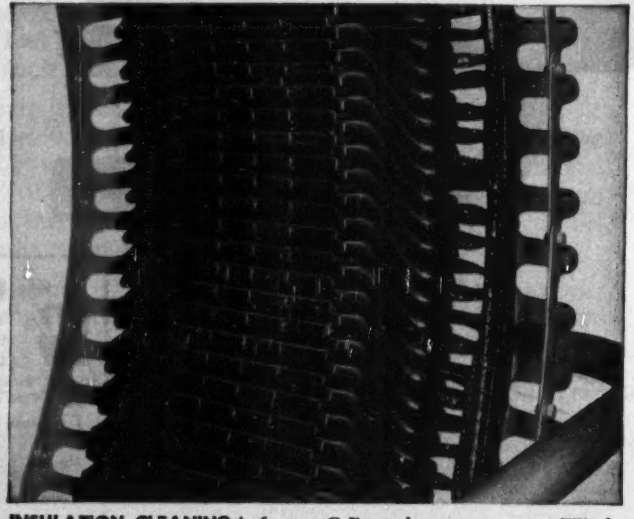


BRUSH-PRESSURE ADJUSTMENT, for maximum brush life, and replacement, to assure reliable motor service, are simple matters on G-E synchronous motors. A calibrated spring-loaded brush holder makes resetting brush tension or removal of brushes fast and easy. Brushes are staggered for even brush-ring wear.

See How Routine Maintenance Is

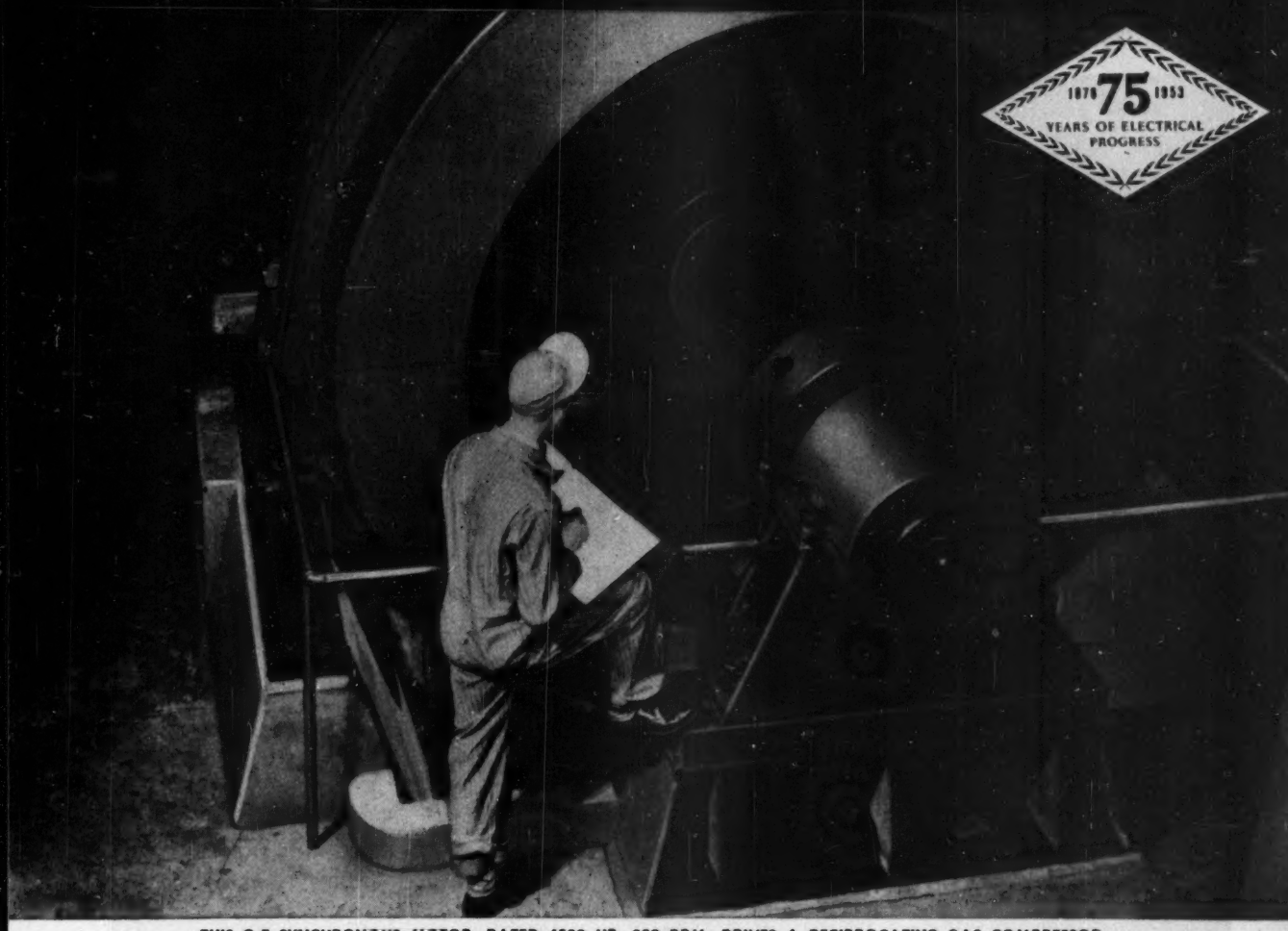


BEARING LUBRICATION can be readily checked through a large sight-level gage on the bearing pedestal; and when oil is required, handy snap-top covers are provided for easy refilling, as well as oil-ring inspection. A drain plug is conveniently located for quick oil changes.



INSULATION CLEANING is fast on G-E synchronous motors. Windings are coated with a high-gloss Glyptal* varnish that resists the accumulation of dust and can be vacuum or air cleaned in most applications. In extremely dusty or oily atmospheres, deposits can be easily wiped from the windings. Clean windings mean longer insulation and machine life.

*Reg. trademark of General Electric Co.



THIS G-E SYNCHRONOUS MOTOR, RATED 4500 HP, 300 RPM, DRIVES A RECIPROCATING GAS COMPRESSOR.

Easier on G-E Synchronous Motors!

Routine maintenance involves three factors: brushes, lubrication, and insulation. To be sure that these areas are properly serviced, G-E synchronous motors have design features that make checking easy and maintenance fast. Close at hand and easy to adjust, the brush-rigging construction encourages your maintenance men to inspect regularly. Oil-level gage and inspection caps are arranged for quick checking and filling when necessary. The high-gloss insulation on G-E synchronous motor windings resists the adhesion of dust and minimizes the need for cleaning.

These features promote long, reliable motor service and save valuable time for your maintenance crews.

Before selecting your next heavy-duty motor, be sure to consider these important maintenance features. Call in your G-E representative. He will be glad to discuss the many money-saving applications for G-E synchronous motors. Meanwhile, you can obtain more information on G-E synchronous motors by requesting the following publications: GEA-5332, "Low-speed Synchronous Motors" or GEA-5426, "High-speed Synchronous Motors." Write to Section 770-28, General Electric Company, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC



If you have HCl corrosion problems . . .

No one metal will economically solve all HCl corrosion problems. But . . .

Years of plant experience as well as extensive laboratory corrosion tests have indicated that Monel withstands the attack of HCl in a wide range of industrial processes. Monel is one of the few metals which show satisfactory resistance in handling dilute solutions of hydrochloric acid.

If you work with organic chlorinations, for example, where small amounts of HCl may form, you will be interested to know that Monel is successfully used for combating corrosion in reactors, lines, valves and other equipment.

With solutions of inorganic acid chlorides, as well, which are apt to hydrolyze to form dilute HCl, Monel has numerous applications in evaporation and handling. And petroleum refineries have for years lined the upper sections of their crude-fractionation towers with Monel to resist HCl produced by hydrolysis of metallic chlorides.

If you handle chlorinated solvents, where danger of dilute HCl formation exists, you may find it profitable to follow the example of others in using Monel for storage tanks and lines. In solvent distillation and recovery, these alloys have proven extremely useful for stills, columns, reboilers and bubble trays and caps.

And if you use HCl—or aluminum chloride—as a catalyst, you will find that many processors have eliminated a large part of their corrosion worries by using Monel for such equipment as reactors, autoclaves, condensers, and vapor and condensate lines. In the manufacture of such compounds as synthetic resins and rubbers Monel has afforded protection not only against corrosion but against contamination and undesirable color effects as well.

It will pay you to take advantage of the vast amount of information on the subject of HCl corrosion which has been accumulated by Inco's Corrosion Engineering Section. No obligation. Just write, giving full details. One of the Inco Nickel Alloys may provide your solution.

It is advisable to place equipment orders with your fabricator well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply you with the latest information on their availability from warehouse and mill.

The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

INCO TRADE MARK

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY® • NIMONICS®
NICKEL • LOW CARBON NICKEL • DURANICKEL®

In the Chemical Industry
where performance counts you can count on Enjay for...

Uniform, High Quality

PETROHOLS

(ISOPROPYL ALCOHOL)



ENJAY

A pioneer and leading marketer of isopropyl alcohols, the Enjay Company offers a complete line of Enjay *Petrohols.* More and more manufacturers are counting on Enjay for their supply of *Petrohols,* methyl ethyl ketone and other Enjay solvents widely used in the surface coating and chemical industries.

A complete line of dependable products for Industry

PETROLEUM	SURFACE COATING	CHEMICAL
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PARATONE	PETROHOL 95	PETROHOL 95
PARAFLOW	PETROHOL 99	PETROHOL 99
PARAPOID	Secondary Butyl Alcohol	Iso-Octyl Alcohol
PARADYNE	Secondary Butyl Acetate	Decyl Alcohol
PARATAC	Isopropyl Acetate	Tridecyl Alcohol
PETROHOL	Acetone	Dicyclopentadiene
Methyl Ethyl Ketone	Methyl Ethyl Ketone	Isoprene
Dewaxing Aid	Ethyl Ether	Butadiene
Ethyl Ether	Isopropyl Ether	Ethyl Ether
Isopropyl Ether	Dicyclopentadiene	Isopropyl Ether
Reference Fuels	Naphthenic Acids	Tripropylene
	Iso-Octyl Alcohol	Tetrapropylene
	Decyl Alcohol	Aromatic Tars
		Acetone
		Methyl Ethyl Ketone

The Enjay Company has long been recognized as a leader in the development and marketing of high-quality products for the oil, surface coating and chemical industries. Backed by greatly expanded plant and distribution facilities, the Enjay Company is supplying a constantly growing list of chemical products to many different industries.

BE SURE TO CALL ON ENJAY FOR YOUR CHEMICAL NEEDS

ENJAY COMPANY, INC.

15 West 51st Street, New York 19, N. Y.

Explosion-Proof CONDULETS*

installed on machines that operate in flammable atmospheres

give YOU maximum protection from explosion and fire

Locations where flammable atmospheres are likely to be present are designated as hazardous by the National Electrical Code. The Code requires explosion-proof electrical installations on machines that operate in such locations or that handle flammable liquids or gases.

The inert gas machine shown at the right operates in a hazardous location. The manufacturer selected Crouse-Hinds' dependable explosion-proof Condulets to control the operation of the machine, to give protection against disastrous explosions and fire, and assure uninterrupted service.

When you design machinery for use in hazardous locations select the very best electrical equipment . . . Condulets that are designed to meet Underwriters' Laboratories' standards. For nearly 50 years, Condulets have been of the highest quality, built from the finest materials, with painstaking care by skilled craftsmen.

The Condulet Catalog lists thousands of types and sizes of junction Condulets, lighting fixtures, plugs and receptacles, switches, controls, and circuit breakers for use in ordinary and hazardous locations. Tell us your electrical promblems. Crouse-Hinds engineers will gladly make specific recommendations.



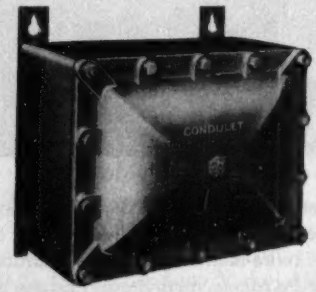
Type EYS Explosion-Proof Sealing Condulet For Vertical Conduit Only



Type EZS Explosion-Proof Sealing Condulet For Vertical or Horizontal Conduit



Type EFS Explosion-Proof 4-Gang Condulet with 2 push-button stations, a double pilot light and 3 tumbler switches. Available in one to 5-gang sizes for all types of control devices.



Type EJB Explosion-Proof Junction Condulet. Used here to make power connections and enclose control devices.

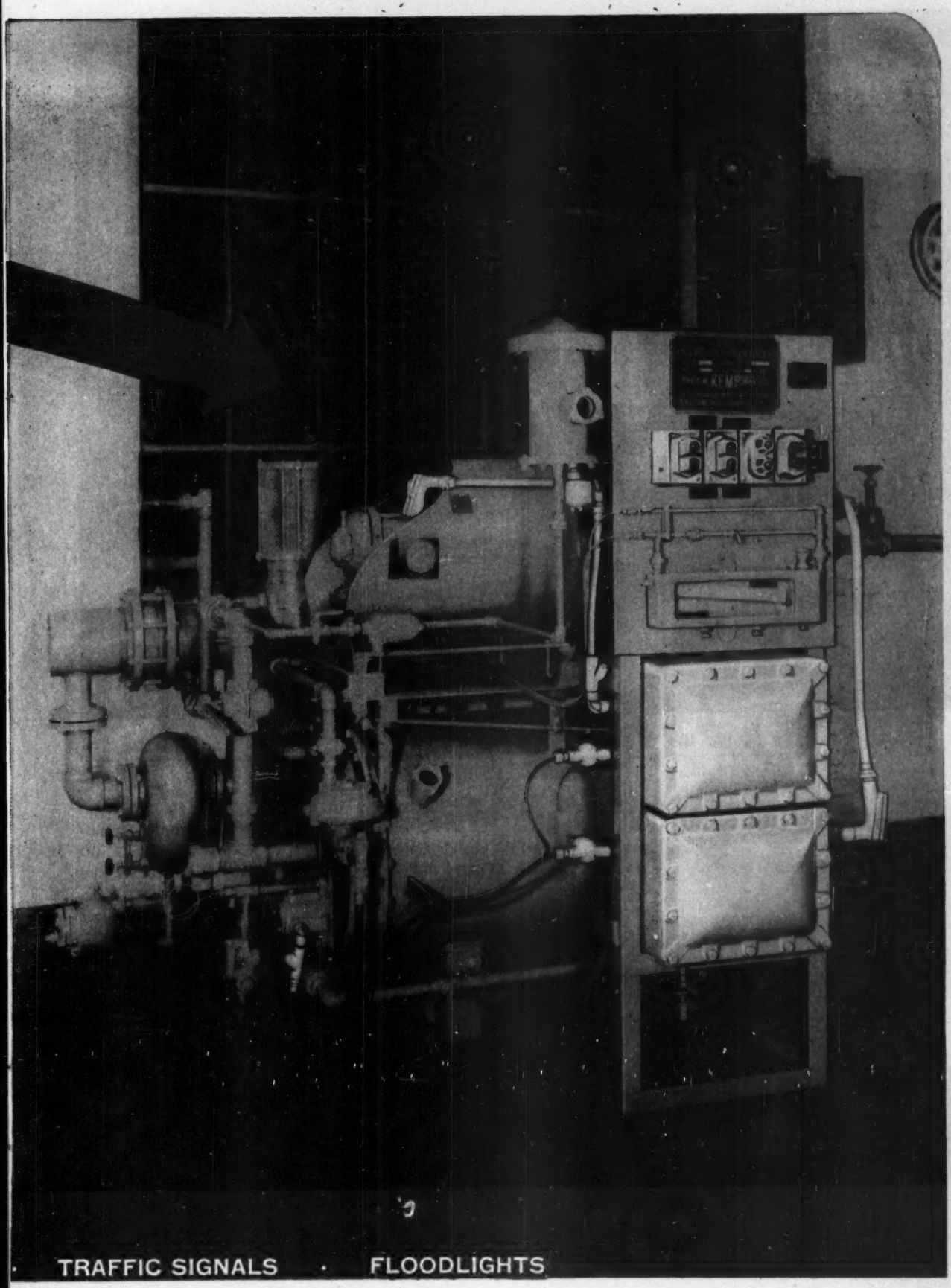
*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CROUSE-HINDS COMPANY
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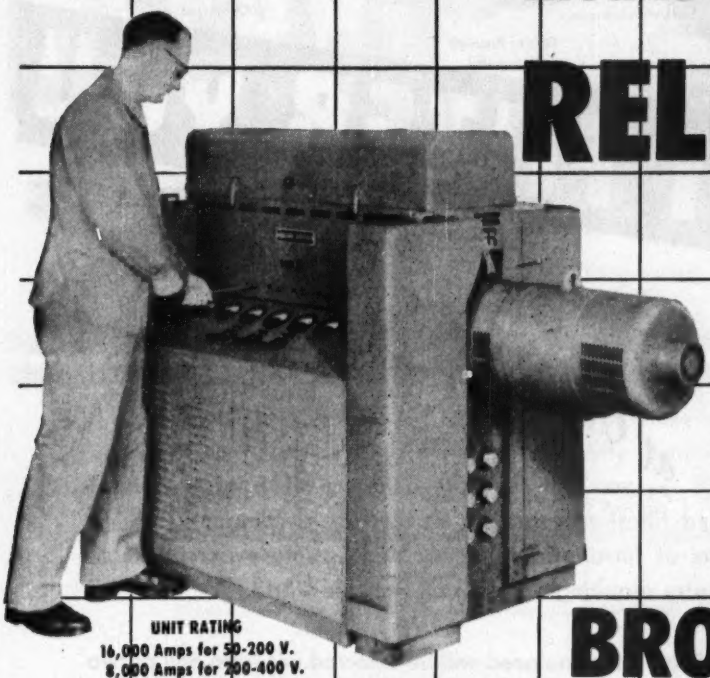


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- A QUICK, SELF-LIQUIDATING INVESTMENT because of the POWER SAVINGS IT MAKES POSSIBLE.

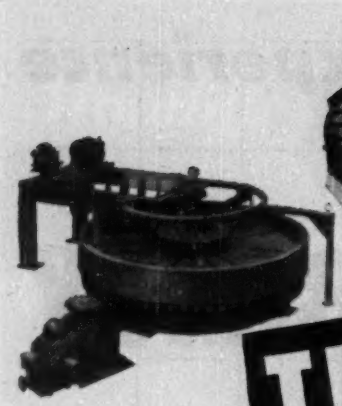
It will pay you to investigate this BROWN BOVERI Mechanical Rectifier.

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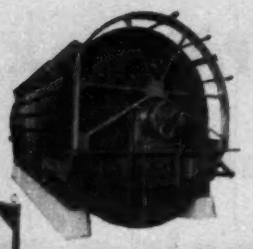
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Please send me data on Mechanical Rectifiers.
Name..... Title.....
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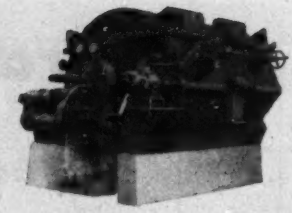
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Oliver Horizontal Rotary



Oliver Panel



Oliver Precoat (Vacuum)



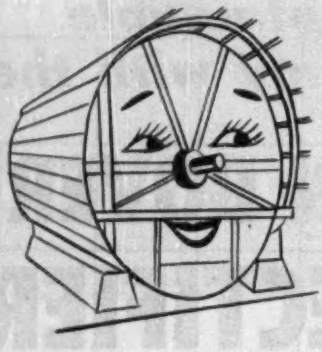
Oliver Chemical

THAT FILTER YOU



Oliver Top-Feed

at Oliver United



* HERE you will have the guidance of a large staff of skilled filtration engineers backed by a company with 45 years of filtration experience and serving every phase of industry requiring filtration all over the world.

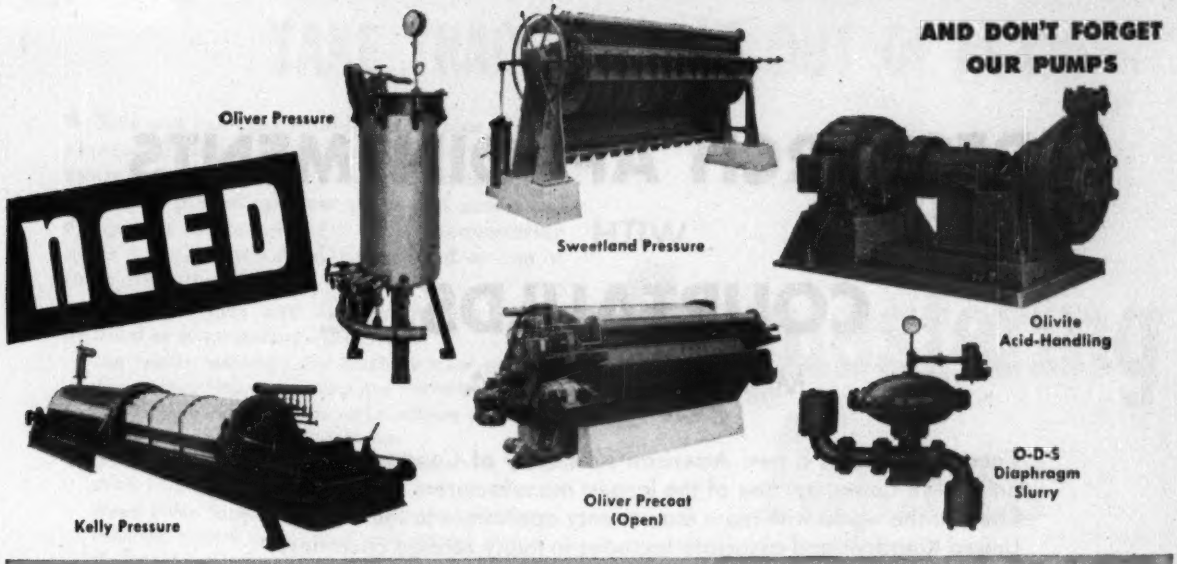
* HERE the filter you need will be selected not from one or two types only—but from nearly a score of distinctly different filter types covering the three principles of filtration: continuous vacuum, continuous pressure, and batch pressure.

Just because it can be assumed that all types of filters will separate solids from liquids, it doesn't follow that all types will make that separation with anything like equal efficiency. Nor will all filters wash the cake properly although washing can be carried on with all filters.

Granting this, isn't it just good common sense to obtain the *best* filtration advice you can get and to make the filter selection from as broad a group of filter types as possible?

Here, briefly, is what you can get at Oliver United: an experience that began in 1907 in the gold mining districts of California where a revolutionary filtration and cake washing method was introduced and *proved sound* . . . an experience that has grown in the past 45 years to cover every processing operation requiring filtration . . . an experience that has gained strength by world-wide filtration service. The other answer to your problem lies in the wide range of Oliver United filter types . . . nearly a score! Check the list at the right and you will see what we mean.

The filtration step in your process is always a most important step. Can you afford not to obtain the best filtration guidance available and the assurance that the filter you buy will be the filter you need?



OLIVER UNITED SELECTIVITY Study These Variations in Oliver United Filter Types with Relation to Your Problem. They Provide a Selectivity Unmatched in Filtration Circles.

Filtration Principle	Filter Type	One Selected Distinctive Feature
Continuous Vacuum	Oliver Chemical	standard for the industry, particularly excellent cake washing
	Oliver Precoat Open	handles thin slimy cakes (cake discarded)
	Oliver Precoat Hooded	same as above but prevents escape of noxious fumes and gases
	Oliver Precoat Vapor Tight	same as above but seals in dangerous fumes and gases
	Oliver Panel	handles thin, slimy sticky cakes (no precoat, cake can be retained)
	Oliver String	for certain kinds of thin, hard-to-handle filter cakes
	Oliver Top Feed	excellent where bone-dry or near-dry cake is required
	Oliver Dewaxing	vapor-tight construction for low temperature dewaxing of lube oils
	Oliver Horizontal	high capacity and excellent washing of crystalline or fibrous materials with high visibility of operations
	American Disc	excellent dewaterer with highest capacity per floor space of any filter
	Dorrco	ideal for dewatering heavy, fast-setting solids
Continuous Pressure	Oliver	same characteristics as standard continuous vacuum Oliver but operable under pressures higher than vacuum equivalent
	Oliver Precoat	similar to Vapor Tight Precoat Filter, operable under pressures higher than vacuum equivalent
Batch Pressure	Sweetland	industry's standard pressure filter, offering high flexibility in leaf type and spacing; pressures up to 50 pounds
	Kelly	used in very high pressure work and where jacketing is required for abnormal temperatures
	Kelly Sulphur	modification of the standard Kelly for cleaning molten Sulphur
	Oliver Pressure	excellent clarifier for polishing beverages, fruit juices, etc.
	Oliver Beatty	use similar to that of Oliver Pressure leaves set radially around a rotatable shaft

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RESEARCH APPOINTMENTS

WITH

COURTAULDS, INC.

MOBILE, ALABAMA

Courtaulds, Inc. is a new American subsidiary of Courtaulds, Limited, an English Company, one of the largest manufacturers of man-made fibers in the world with more than twenty operations in the United Kingdom and associate factories in many foreign countries, principally Canada, Germany, Italy, France, Spain and Australia.

The Courtaulds Group and its associated companies are engaged in the manufacture of viscose, acetate and nylon yarn and staple, and cellophane, as well as wood pulp and chemicals used in synthetic fiber manufacture. It also has extensive weaving, knitting, dyeing and finishing operations.

With the opening of a new Courtaulds rayon plant in America, Courtaulds, Inc. intends to create an expanding research organization over the whole field of man-made textile products equipped with completely modern facilities in a new research laboratory.

During 1953 it will add to its staff several research associates, who will be selected competitively on the basis of their letters of application, supported by transcripts of their academic accomplishments. Those interested must have studied in one or more of the following fields:

Physical Chemistry
Organic Chemistry
Chemical Engineering
Physics

It is necessary that they demonstrate a strong desire to do industral research work, particularly in the field of cellulose chemistry and its application to production problems. A Doctor's degree is not necessary but it is mandatory that the candidates have done some original research work on the graduate level.

Successful applicants may be asked to travel abroad for study in the research laboratories of Courtaulds, Limited, in England in collaboration with the most outstanding research scientists and technicians in the synthetic fiber industry.

These appointments carry with them attractive salaries in an interesting and expanding field of industrial research in the most modern facilities, with excellent opportunities for recognition of the individual's work.

Applications are now being received. All applicants should apply by letter, giving complete details of their personal background and a general outline of their professional training, supported by official transcripts. A statement concernin the individual's aspirations in the field of cellulose chemistry and industrial researcl should be included in the letter.

All inquiries and applications will be treated in strictest confidence and should be addressed to:

A. E. Jakeman
Director of Industrial Relations
Courtaulds, Inc.
P. O. Box 1025
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TAKE TRACE METALS OUT OF ACTION!

● Now you can take troublesome traces of iron, aluminum, copper and other metals out of action easily and effectively. The answer to metallic contaminants picked up from pipes and processing equipment is the use of a Pfizer sequestering agent . . . Gluconic Acid, Citric Acid or one of their derivatives.*

Pfizer Citrates and Gluconates are recommended as sequestering agents in:

The textile industry . . . to inactivate trace metals in dyeing, bleaching, kier boiling and mercerizing.

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Oil and fat industry . . . to inactivate trace metals which lead to rancidity.

Weed killer formulations . . . to prevent formation of insoluble, inactive salts in hard water areas.

Municipal and industrial water systems . . . to prevent the precipitation of metallic contaminants.

Bring your metallic contamination problems to Pfizer. Write for Technical Bulletin #32.

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*Sodium Citrate, Sodium Gluconate, Ammonium Gluconate

Pfizer Sequestering Agents

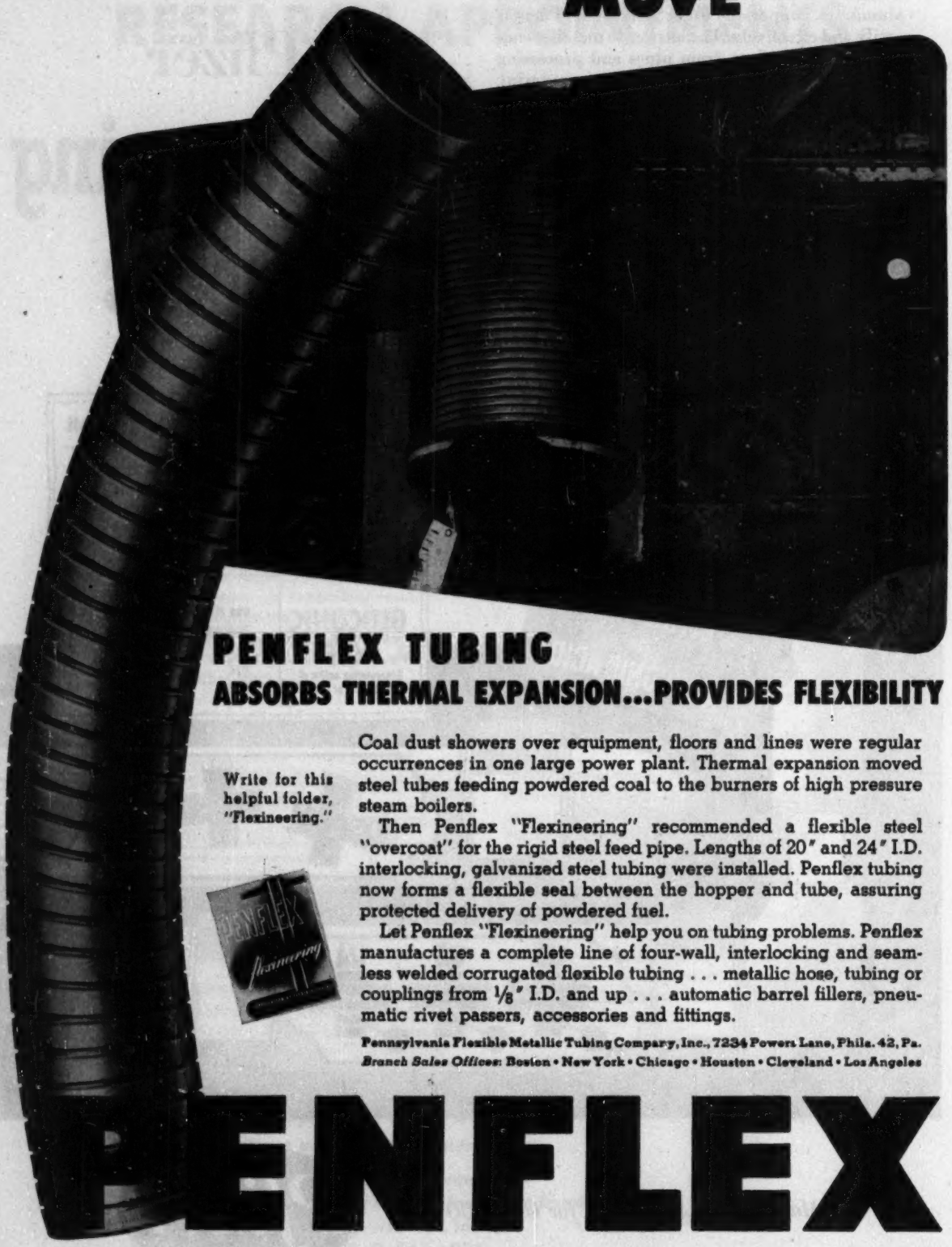
PUT "IN"	SEQUESTER "OUT"		pH
CITRIC ACID Sequestering action of 100 parts of acid	Iron (Ferric)	19 Parts	7
	Aluminum	19 Parts	7
	Copper	26 Parts	7
	Zinc	44 Parts	7
	Cobalt	95 Parts	10
GLUCONIC ACID Sequestering action of 100 parts of acid	Iron (Ferric)	24 Parts	7
	Aluminum	4 Parts	7
	Copper	26 Parts	7
	Zinc	27 Parts	7
	Cobalt	6 Parts	10



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ABSORBS THERMAL EXPANSION...PROVIDES FLEXIBILITY

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SPERRY

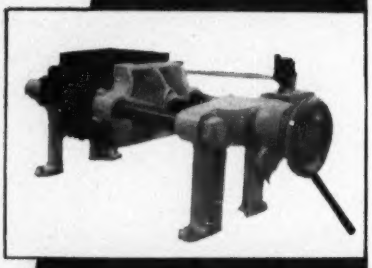
FILTER PRESSES

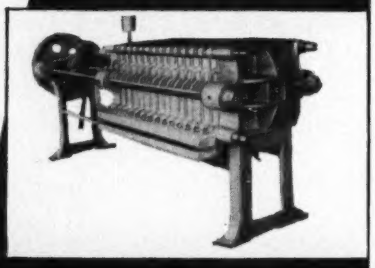
Designed and Made to Meet YOUR Industrial Filtration Problems

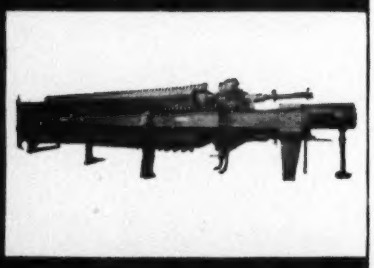
Hundreds of the foremost manufacturers in the country, employing nearly every known type of industrial filtration, rely upon Sperry Filter Presses for the finest answers to their filtration problems.

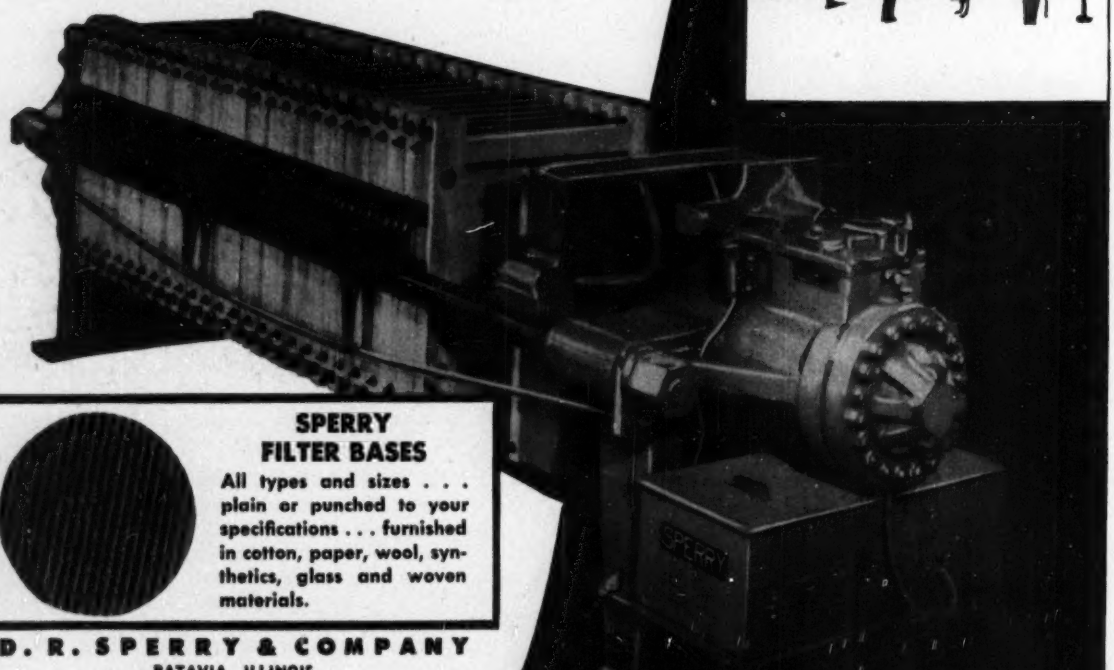
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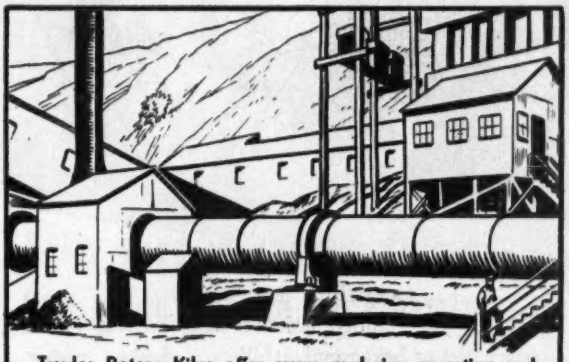
SPERRY FILTER PRESSES



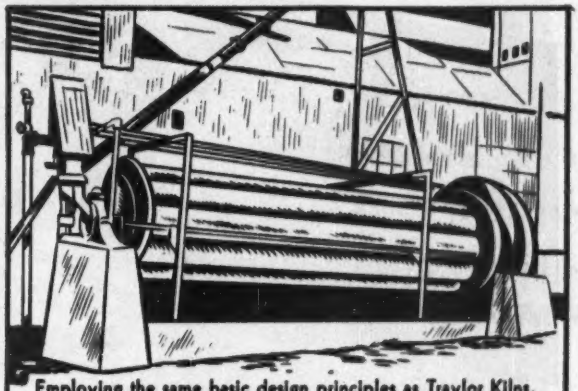
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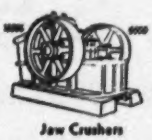
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Primary Gyratory Crushers

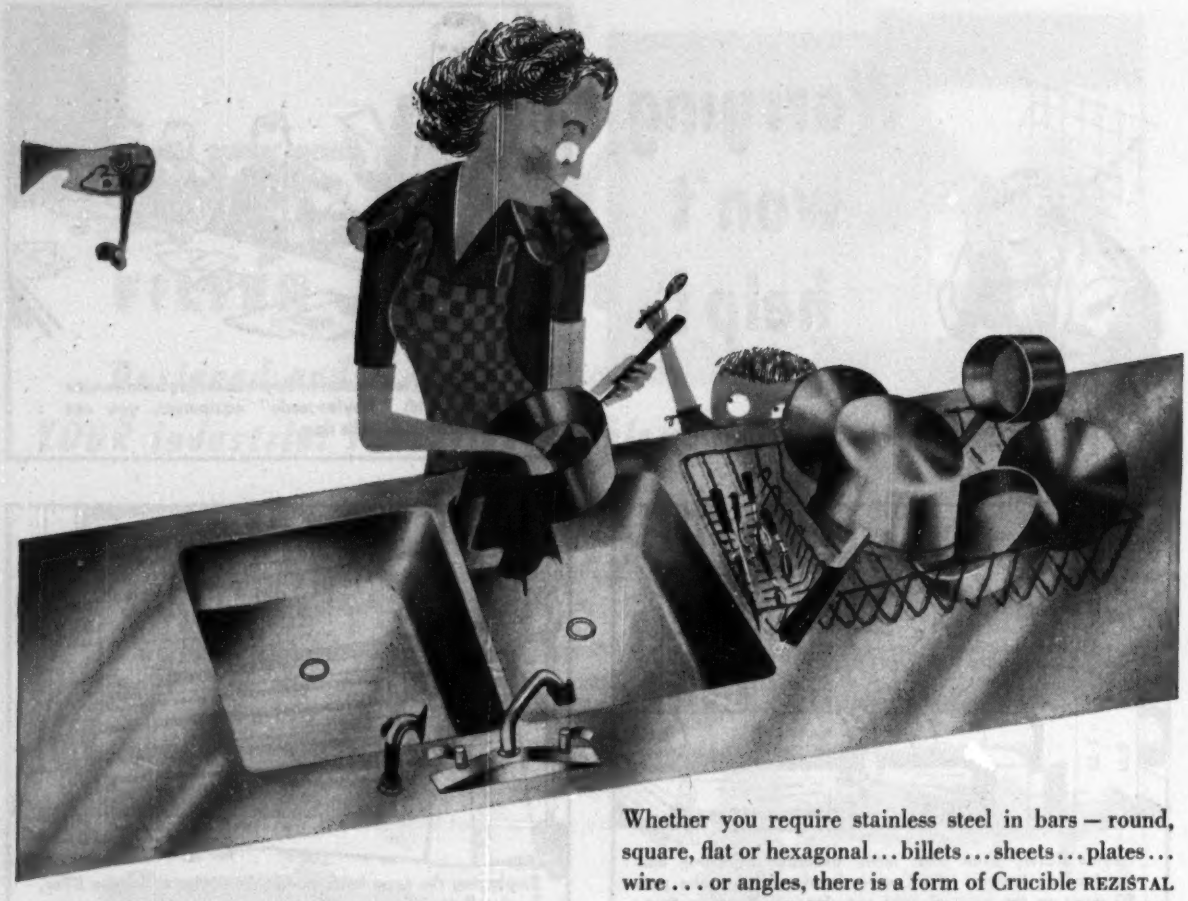

Rotary Kilns


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If you have a specialized application where the unique qualities of stainless will improve your product or your processing operations, don't hesitate to call in a Crucible representative who can give you the benefit of our broad experience. And when you buy stainless, be sure you specify Crucible REZISTAL, the quality brand of heat and corrosion resistant steels.

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STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

CORROSIVE VAPORS HANDLED BY WORTHINGTON STEAM JET EJECTORS

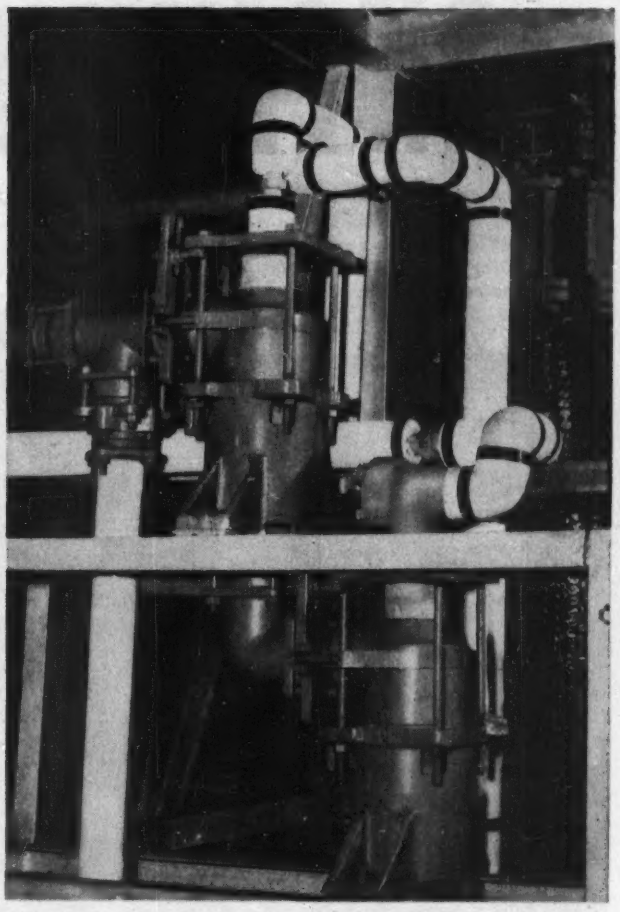
Units used in vacuum process for manufacture of vitamins

In making synthetic vitamins at the Rahway, N. J., plant of Merck & Co., Inc., large quantities of corrosive vapors must be handled.

Worthington impervious graphite steam jet ejectors have been doing the job for years. And wherever corrosive vapors must be handled in vacuum operation—there you will find Worthington steam jet ejectors in heavy-duty operation.

There's a Worthington ejector for every vacuum requirement—from atmosphere to 50 microns absolute, single and multiple stages, condensing and non-condensing, of stainless, bronze, porcelain, impervious graphite, Worthite, cast iron and steel.

Take advantage of Worthington's years of experience in vacuum systems. Write and tell us about your specific requirements. Worthington Corporation, Steam Power Division, Ejector Section, Harrison, New Jersey.

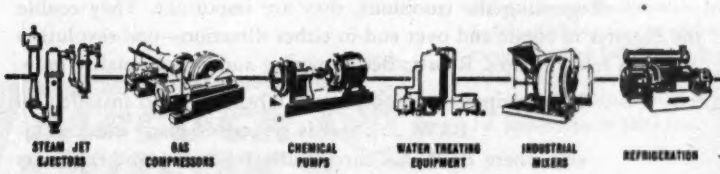


WORTHINGTON TWO-STAGE IMPERVIOUS GRAPHITE STEAM JET EJECTOR used in synthetic vitamin manufacture at the Merck plant in Rahway, N. J. This unit is one of thirty-eight Worthington ejectors used at the plant.

6 BIG ADVANTAGES OF STEAM JET EJECTORS FOR VACUUM SERVICE

1. *LOW INITIAL COST.*
2. *MINIMUM OPERATING COSTS.*
3. *NEGLIGIBLE MAINTENANCE COSTS.*
4. *NO MOVING PARTS.*
5. *EASY TO OPERATE.*
6. *AVAILABLE IN ANY MACHINABLE MATERIAL.*

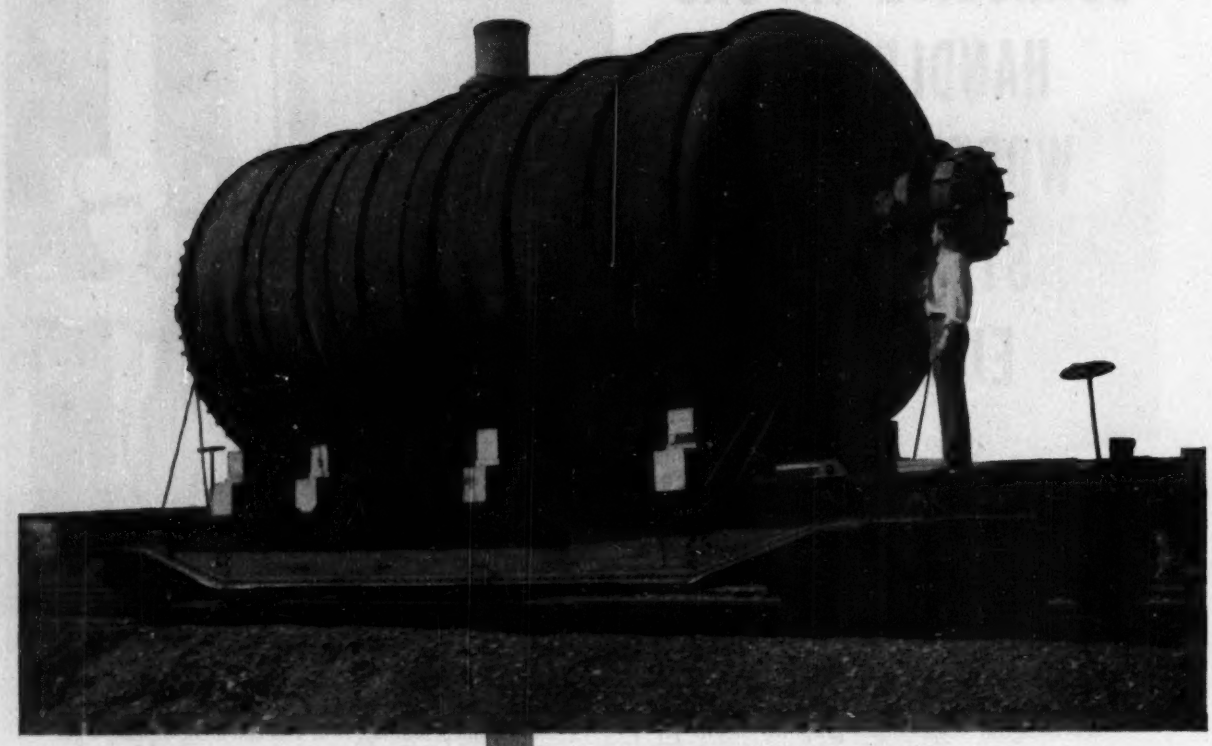
X-2.4



WORTHINGTON

Steam Jet Ejectors

LINTERS...STEAM...



One of six rotating digesters designed and built by B&W for the Buckeye Cotton Oil Company. Dimensions: 31 ft 3 in. long, 11 ft I.D. Working pressure: 165 psi. Temperature: 350 F. Material: Shells, heads and cones to ASME Spec., SA-212 Grade A, 65,000 tensile strength steel.

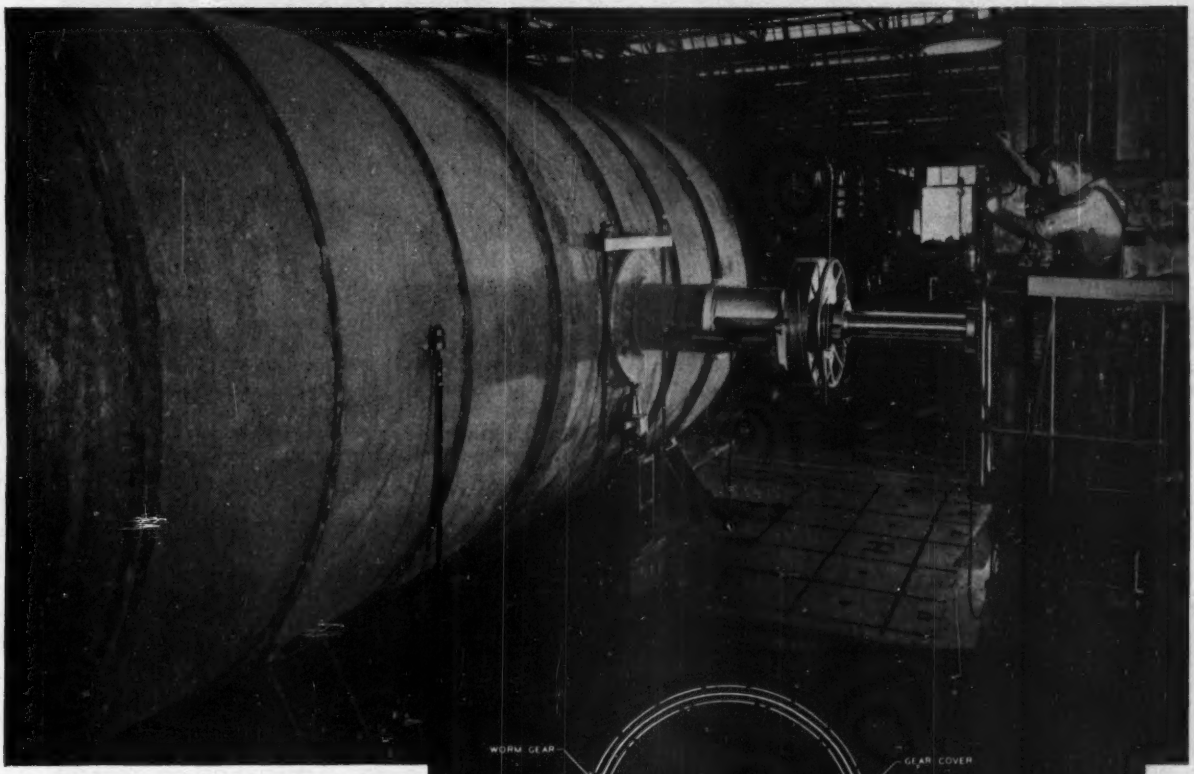
Starting with cotton seed linters, Buckeye Cotton Oil Company makes pulp which eventually becomes rayons and plastics. The linters, with steam and a caustic solution, are cooked in large digesters. (Buckeye, a Procter & Gamble subsidiary, is located at Memphis, Tenn.).

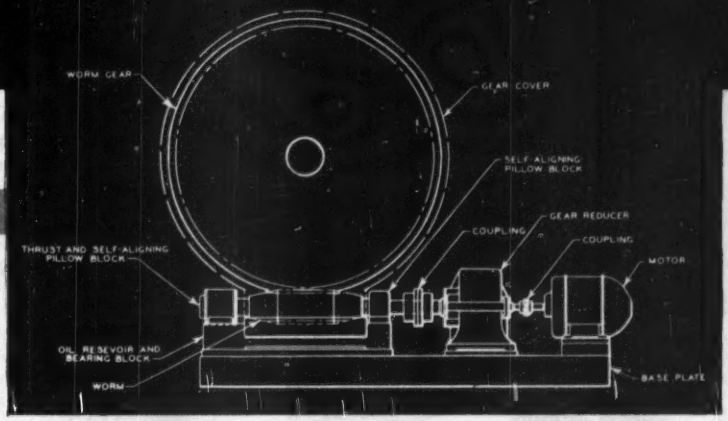
Regarding the trunnions, they are important. They enable the digester to rotate end over end in either direction—one revolution in four minutes. Result: Better mixing and a high quality pulp.

This equipment was designed, fabricated, and installed by B&W . . . and is typical of many other projects where B&W has successfully relieved plant engineers of tough engineering problems. The Babcock & Wilcox Company, Process Equipment Dept., Barberton, Ohio.

COOK...TRUNNIONS...

Each digester rotates end over end on two separate forged steel trunnions of 16 in. diameter, welded onto a heavy steel girth band around the center section of the vessel. This B&W trunnion design is markedly superior to conventional through-shaft construction because it distributes weight-stresses over a large area of the shell, greatly increasing corrosion-resistance at these critical points. Trunnions are supported by two heavy water-cooled bearings.





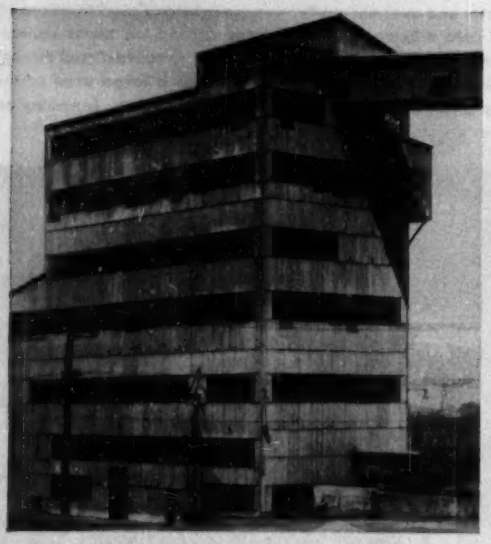
Individual drive mechanisms for the digesters also were engineered and built by B&W to assure satisfactory operating conditions, with a maximum torque load of 540,900 ft-lb and an end thrust of 118,000 lb created by shifting center of gravity when digester is partially filled. Provision for either-direction rotation simplifies vertical positioning of digester for connecting to blow line.

BABCOCK & WILCOX

S-416

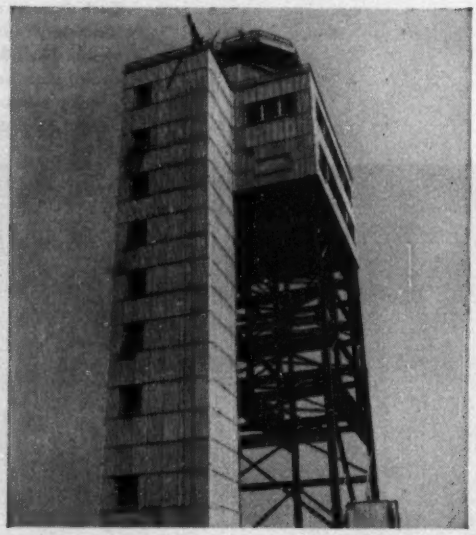
CORRUGATED *Asbestos* TRANSITE*

For Permanent Construction



This large coal breaker, roofed and sided with Johns-Manville Corrugated Transite, will provide many years of fire safety and low cost maintenance.

For Permanent Protection



Johns-Manville Corrugated Transite effectively protects the delicate instruments in this new airport control tower from the effects of severe weather conditions and fire.

You build economically and quickly with these versatile fireproof and weatherproof asbestos building sheets

In the past quarter century, Johns-Manville Corrugated Transite has proven an ideal material for roofs and for sidewalls of industrial, commercial, institutional and agricultural buildings. Made of asbestos and cement, the large sheets are easy to handle, go up quickly with a minimum of framing. Practically indestructible, Corrugated Transite is fireproof, rotproof, weatherproof, needs no paint or special treatment to preserve it, and can be salvaged and re-used if necessary.

Today, Corrugated Asbestos Transite is also used increasingly for smart interiors . . . the streamlined corrugations and attractive shadow lines that give it such unusual architectural appeal for exteriors offer unlimited interior design possibilities.

• • •

Investigate J-M Corrugated Asbestos Transite and learn how you can build quickly and easily... have an attractive, long-lasting, trouble-free structure regardless of size or purpose. For complete details write Johns-Manville, Box 158, Dept. CE, New York 16, N. Y. In Canada write 199 Bay Street, Toronto, Ontario.

*Reg. U. S. Pat. Off.



EASY TO FASTEN TO STEEL



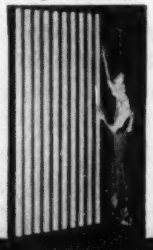
EASY TO SAW



EASY TO DRILL

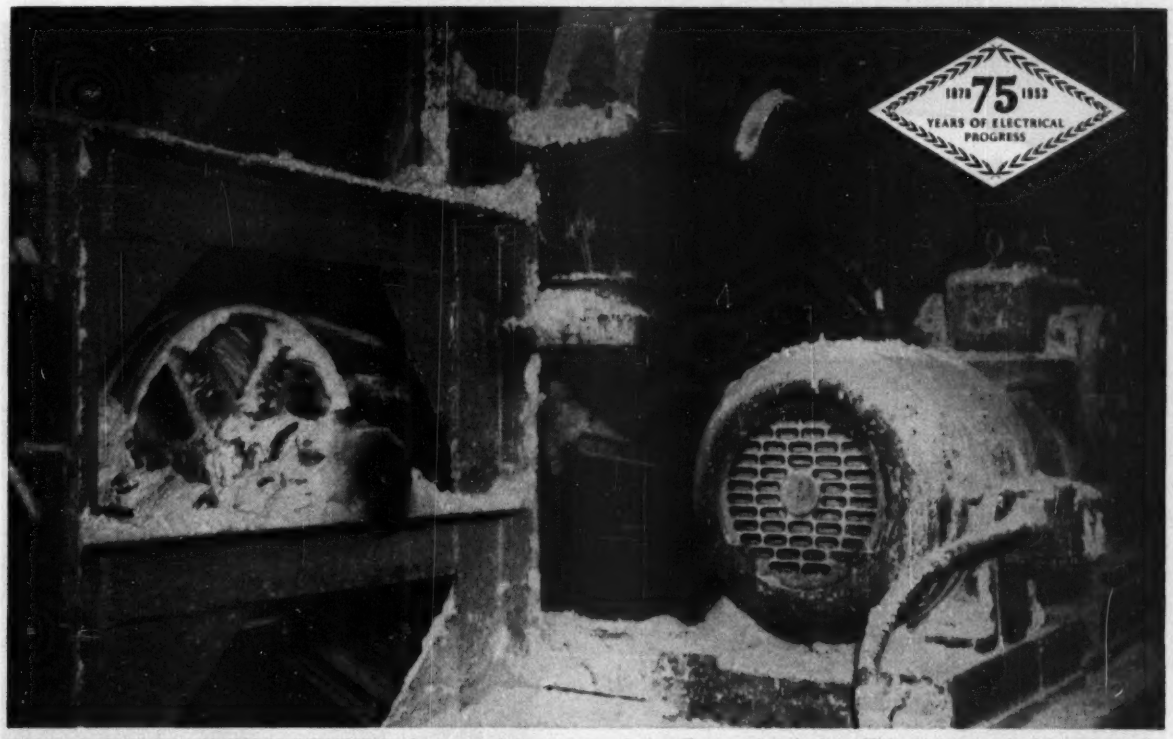


EASY TO NAIL TO WOOD



JM

Johns-Manville *Asbestos* **CORRUGATED TRANSITE**



THROUGHOUT THE CHEMICAL INDUSTRY, the tough jobs are done by General Electric Tri-Clad TEFC motors with corrosion-resisting Formex insulation. This 7½-hp unit drives a crude-ash conveyor an average of over 23 hours every day.

Field-tested insulation protects this true chemical motor against breakdowns

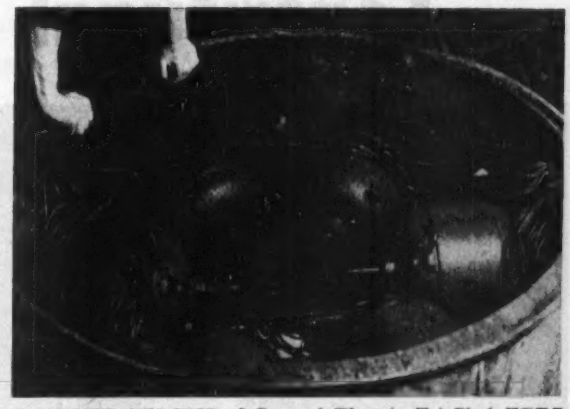
Only G-E standard Tri-Clad* TEFC motor has quadruple-Formex* insulated wire

One of many reasons why chemical plants have so widely accepted General Electric's standard Tri-Clad totally enclosed fan-cooled motor as *the* chemical motor is its superior insulation system, which stands up against moisture and corrosive fumes.

Quadruple-Formex insulated wire—finest insulated magnet wire available—is used for coil windings. Developed and licensed by G.E., this self-protecting wire is also coated with multiple dips and bakes of high-quality synthetic resin varnish and Glyptal* red bonding material. In addition, voltage-surge, salt-spray, and many other factory tests insure extra protection against motor breakdown.

For full data, ask your G-E Apparatus Sales representative or write for Bulletin GEA-4400 to General Electric Co., Sect. 662-42, Schenectady 5, N. Y.

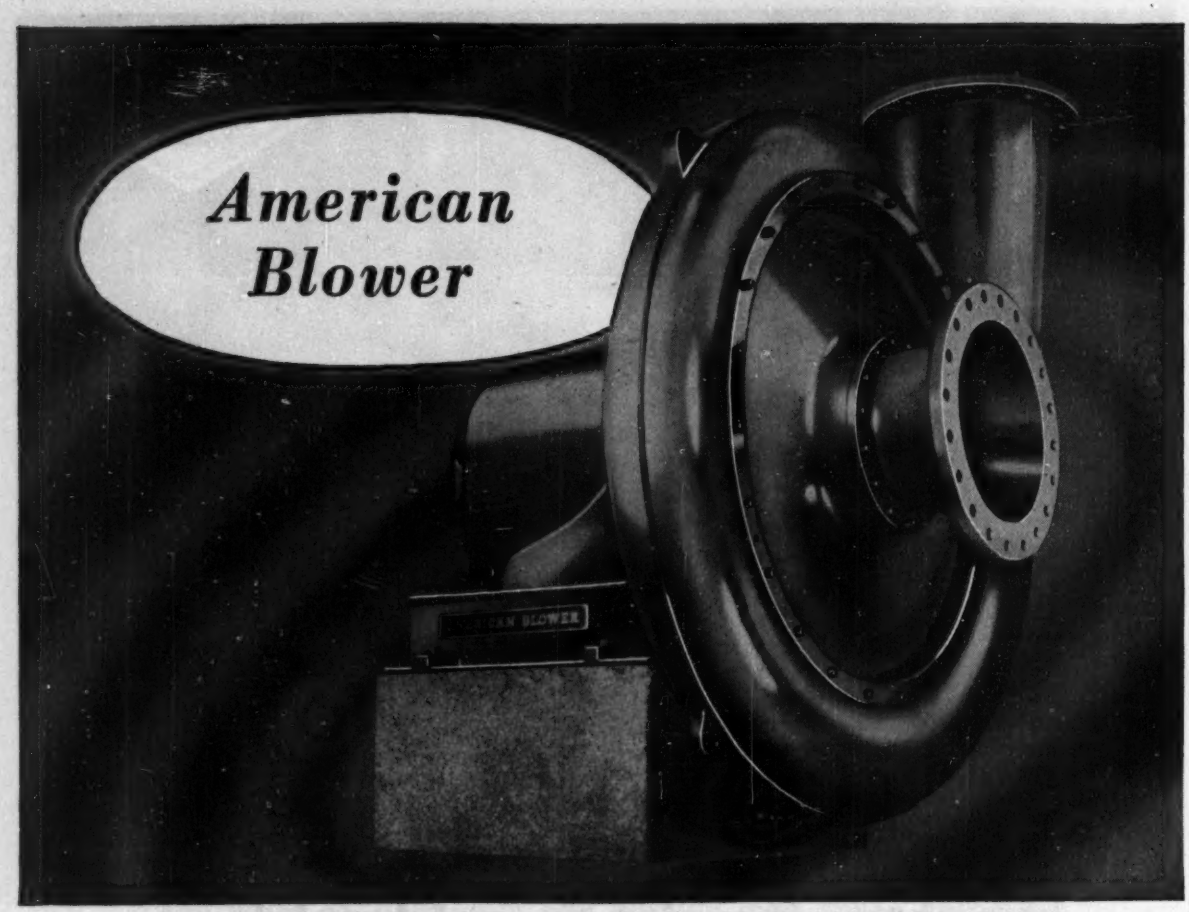
*Registered trade-mark of General Electric Company.



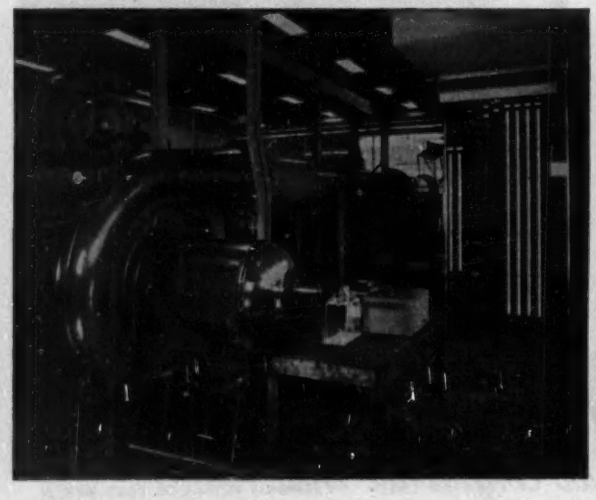
SIMULATED LIFE TEST of General Electric Tri-Clad TEFC motors in a salt-spray tank. This is one of several rigid tests that help assure dependability in chemical industry service.

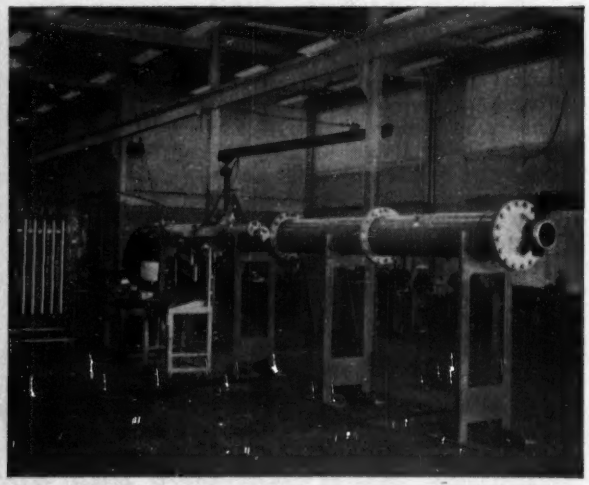
You can put your confidence in—

GENERAL ELECTRIC



Centrifugal Compressors





Prior to shipment, each compressor is thoroughly tested for mechanical and performance characteristics in accordance with the A.S.M.E. Power Test Code in American Blower's modern research and testing laboratory.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS

They're compact, require minimum foundations, are adaptable to all types of drives

Use Them Profitably for These Jobs

AIR COMPRESSION
ANNEALING FURNACES
CATALYST REGENERATORS
COAL PULVERIZATION
CUPOLAS
CYCLONE FURNACES
FORGING FURNACES
GAS BOOSTERS AND EXHAUSTERS
LEAD AND COPPER FLOTATION
PNEUMATIC CONVEYING
OIL-GAS GENERATORS
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SINTERING
WATER-GAS GENERATORS

American Blower Single Stage Centrifugal Compressors are basically variable-volume, constant pressure compressors, built to deliver efficiently large volumes of air or gases at high pressures.

You can buy them in sizes from 30 to 600 HP with pressures from 1¼ to 3¾ lbs. In addition, any American Blower Centrifugal Compressor can be equipped with controls to meet specific job requirements — such as constant inlet volume, constant suction pressure, constant discharge pressure, or constant weight flow.

For technical data, consult the nearest American Blower Branch Office or write us for Bulletin 109.

Whether you need equipment for heating, cooling, ventilating, air conditioning, vapor absorption, fume removal, dust collecting, mechanical draft, heat transfer or smooth power transmission thru Gyrol Fluid Drives — American Blower manufactures a complete line of products to meet your requirements. Helpful technical literature is available on each product.

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CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

& WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

A Progress Report on the Status of FluoSolids

Applications of Non-Catalytic Fluid Techniques Expanding into Many New Fields

Pioneered by Standard Oil Development Company during World War II, fluidization is today widely recognized as an ideal means of promoting intimate contact between solids and gases. As licensee in all non-catalytic non-hydrocarbon fields, The Dorr Company has continually expanded the applications of this new technique since 1944. At the present time, FluoSolids is demonstrating outstanding advantages in the processing of a wide variety of metallic and non-metallic minerals, and holds great promise for the future in other fields not yet fully developed.

GOLD

One of the first applications of the Dorrco FluoSolids System was the roasting of arsenopyrite gold ores prior to cyanidation, and several installations have been operating with marked success for two to five years. Latest development for gold roasting is the split compartment Reactor. In this type of unit, preliminary reducing conditions are provided in one half of the Reactor and a complete oxidizing roast in the other, resulting in decreased cyanide consumption and better metallurgy at the mill.

PYRITE

The sulfur shortage has contributed to great activity in the pulp and paper field. Eight FluoSolids Systems in the U. S., Canada and Norway are either in operation or under construction in sulfite pulp mills, for the production of SO_2 for cooking liquor. Eight more are in operation or being installed to produce SO_2 from pyrite, pyrrhotite and low grade sulfur ores at acid plants, which will produce over 1200 tons per day of H_2SO_4 by the contact method. This impressive record results directly from the fact that FluoSolids can deliver a high strength SO_2 gas at lower investment and operating costs than conventional roasters and provides users with an economically feasible and reliable source of SO_2 despite fluctuations in natural sulfur supply.

ZINC

The first commercial FluoSolids installation for the roasting of zinc concentrate went into operation in the summer of 1952. It is producing SO_2 gas for sulfuric acid manufacture and a desulfurized zinc calcine for leaching, prior to electrolytic zinc production. Results to date have demonstrated marked simplicity of control and operation, and two other zinc producers have ordered similar Systems.

COPPER

More recently, the first FluoSolids System to provide a sulfating roast to a copper-zinc concentrate went into operation. In this application, close operating controls make it possible to render the valuable base metals soluble and, at the same time, minimize solubility of the iron. This permits high recoveries of copper and zinc by leaching. When followed by electrolytic precipitation, economic advantages are indicated under many conditions as compared with conventional smelting practice.

NEW DEVELOPMENTS

Studies to explore the utilization of FluoSolids for the beneficiation of low grade iron ore are now being conducted. In this operation, hematite is given a reducing roast to convert it to magnetite for subsequent concentration by wet magnetic means. Higher unit recovery of iron and the production of better concentrate grades indicates improved economics as compared with other beneficiation methods.

Among the other numerous fields currently under investigation are the calcination of alumina, the reburning of precipitated lime sludge and the self roasting of low grade sulfur ores.

If you would like more information on FluoSolids — the most significant advance in roasting technique in the last 30 years — write The Dorr Company, Stamford, Conn. or in Canada, The Dorr Company, 26 St. Clair Avenue East, Toronto 5.

FluoSolids is a trademark of The Dorr Company, Reg. U. S. Pat. Off.

If you've never used this—



maybe you should

It's UNIFLEX...

The new Helically-corrugated Seamless Flexible Tube

If you have a process or application involving flexible metal hose, it will pay you to know a few facts about UNIFLEX. For this entirely new, *seamless* flexible tubing is just coming into its own—in applications too critical for ordinary concentric tubing.

Consider . . .

1. We make UNIFLEX from seamless, special bronze alloy tube—tough, corrosion-resistant, leak-proof.

2. Helical corrugations give UNIFLEX greater flexibility and longer life. Our unique method of manufacture eliminates embrittlement resulting from excessive work-hardening.

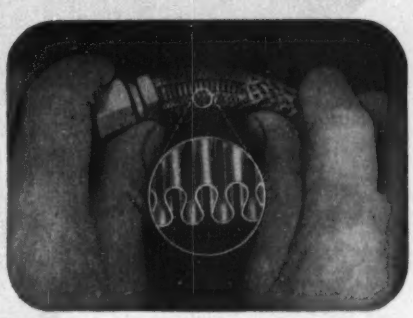
3. For leakless service, UNIFLEX fittings have metal-to-metal seat. Seal is produced through spring washer effect of hose on fitting body.

4. Unlike conventional split-ring collars used on concentric tubing, the *one-piece* UNIFLEX collar hugs 4 or 5 convolutions. This means far less wear —and much greater strength in the connection.

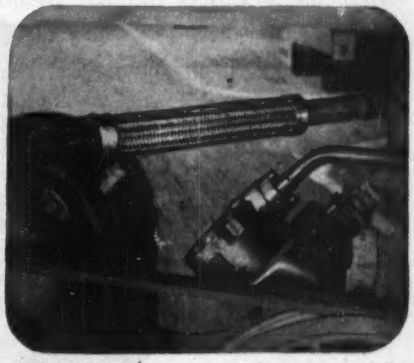
5. UNIFLEX is encased in high-tensile bronze wire braid attached to specially designed couplings. Hose is relieved of damaging strains; sheath prevents elongation, gives extra safety, withstands abrasion.

6. UNIFLEX helical construction distributes flexing between inner and outer surfaces of convolutions —eliminates strain usually limited to one groove. Result: Greater safety and longer life.

7. UNIFLEX fittings are shorter and more compact than most others. This permits the use of more hose length and less fitting length—gives far greater maneuverability, makes it easier to get in and out of tight places.



Note the Helically-corrugated, seamless wall structure of UNIFLEX.



UNIFLEX vibration eliminator used between circulating coils and compressor of a General Electric air conditioning unit. Motor-compressor unit is spring-mounted, requires a flexible connection.

UNIFLEX is supplied in measured lengths, properly fitted and ready for use. You can buy it in sizes from ¼" to 6" ID. It has already proved itself in such applications as hydraulic lines, oil burners, refrigeration machinery, air conditioning equipment, pumps, compressors, diesel engines and machine tools. Our Designers and Engineers have a thorough knowledge of its behavior under exacting conditions. If you'd like to know what UNIFLEX can do for *you* write us about your problem. We'll be glad to help you—without obligation.



Send for your free copy of our new UNIFLEX Catalog. It contains full technical data, sizes, fittings, suggestions for use, and information about new UNIFLEX Quick-soldered Couplings..

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REGISTERED TRADE MARK

CORROSION ?

Beat it with this Bonderized pair

You can install this Life-Line chemical motor and Life-Linestarter® team, any place and be sure. They're tough, dependable. Extra-protected, inside and out, and Bonderized to beat off corrosion's attacks. Look at the motor, for example.

Its specially treated, rolled-steel frame constantly has proved its ability to outlast conventional frames. Why?

In the first place, the frame is heavy-gauge, Bonderized steel. Then, special formaldehyde-alkyd-type enamel and succeeding layers of Thermoset varnish plus final lacquer are applied. That makes a tough hide to ward off corrosion's sabotage.

Too, Life-Line pre-lubricated, factory-sealed bearings guard against acid and other bearing enemies. This one feature alone has doubled bearing life . . . multiplied it many times in some plants. Lubrication maintenance is eliminated.

Life-Linestarters are also Bonderized—the only standard Bonderized starter available today at no extra cost. That's why, in corrosive atmospheres, the Life-Linestarter has rendered substantial savings to users. In places where local electrical codes formerly specified expensive, hot-dipped galvanized or cadmium-plated enclosures, the Life-Linestarter is now acceptable.

Together, you can't beat this team for corrosion resistance. Put them together on your applications and save. Discuss the details with your Westinghouse representative. He has the facts to help you stop corrosion raids. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21630

YOU CAN BE SURE . . . IF IT'S Westinghouse

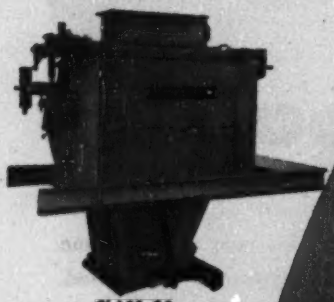
Life-Line

MOTORS and CONTROLS

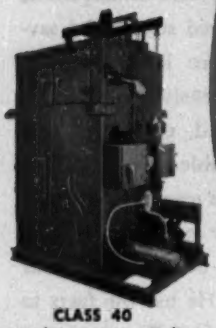
what can WE do for YOU Mr. Processor?



CLASS 50
Dust-tight, all-electric, high-speed, accuracy-indicating scale for weighing dry, ground, granular, dusty, non-free-flowing and some small lumpy materials. Bulletin 3649.



CLASS 38
Dust-tight, heavy-duty scale for dry, ground, dusty, non-free-flowing materials. Bulletin 8946.



CLASS 40
Accommodates screw, belt, or vibrating feeder for handling wide range of materials. Dust-tight, solenoid- or motor-operated discharge, accuracy-indicating. Bulletin 1449.



CONTROL PANEL
Richardson-designed panels such as this control whole automatic weighing systems composed of scales like those at the left.

Frankly, that's the reason we're running this ad—not to tell you about our products, but to ask you about your plant problems. Because if your business involves the handling of any materials or liquids by weight, we think you probably have an operation or two which just doesn't measure up in efficiency, economy, or speed. We'd like to know about it, because we think we can help.

You can call it pride, or conceit, or self-satisfaction, or self-confidence, but our engineers have never been stumped for long by a problem in materials-handling by weight—and in fifty years of working with the biggest names in American industry we've seen a lot of them! From aluminum sulphate, to zinc oxide, and back to almonds we've successfully installed Richardson units or systems to handle just about everything in the book, and built a lot of goodwill and a fair-size company in the process.

Naturally, if a Richardson Scale can contribute to the smoother, faster, or more profitable operation of your plant, we'd like to sell you one. We think that our products and experience can help in solving your problem in processing, and if you'll outline it, we'll be glad to have one of our field engineers arrange to go over it with you.

Or, if you'd just like to know more about Richardson Scales for possible future reference, simply clip this ad to your signed letterhead and mail. Bulletins 0450, 0550, and 0351 will be sent you by return mail—no obligation.

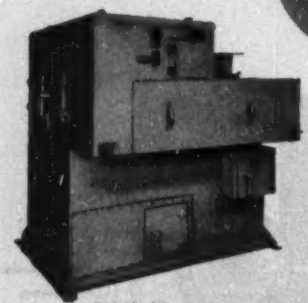
The Richardson Scale Company, Clifton, N. J., will be glad to supply information on:

Feeder-Weigher Systems • Automatic Bulk Weighing Hopper Scales • Automatic Bagging Scales • Bag Sewing Conveyors Packers • Process Control Panels and Select-O-Weigh

Please write direct to our Clifton office, or to the nearest of our branch offices located in Atlanta, Boston, Detroit, Minneapolis, Cincinnati, Wichita, Montreal, Omaha, New York, Pittsburgh, San Francisco, Toronto, Buffalo, Chicago, Philadelphia, Houston, St. Louis.

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1901



CLASS 39
Self-contained, dust-tight, belt-feeding and weighing unit. Accuracy-indicating for process or intermittent batch weighing of lumpy, crushed, sluggish materials. Bulletin 1549.



CLASS 56
Self-checking, automatic feeder-weigher for large tonnage; practically continuous stream delivery. Beam system has approval of all weighing authorities. Bulletin 2140-2.



SELECT-O-WEIGH
On electronic weight control system providing remote, instantaneous, dial-control formula changing and ingredient selection for all proportioning applications. Bulletin 0351.

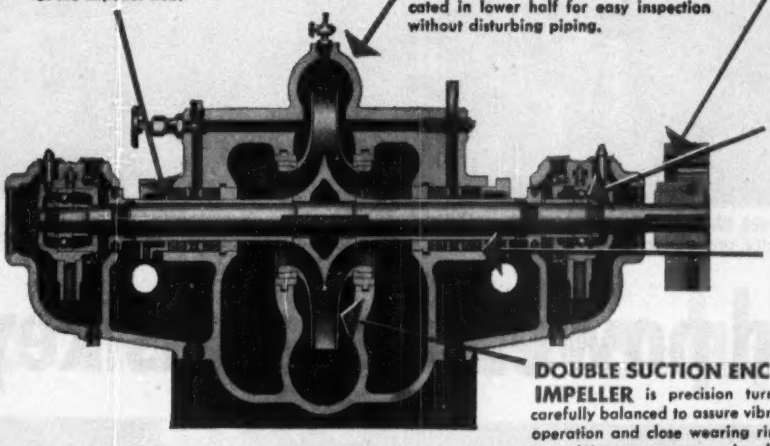
8369

Look for These 7 Signs of GOOD PUMP DESIGN

CAST SHAFT SLEEVES, not commercial tubing, save the shaft from wear. Sleeves extend through the stuffing box and seal at the impeller hub.

HEAVY HORIZONTAL SPLIT CAST-IRON CASING construction with suction and discharge nozzles located in lower half for easy inspection without disturbing piping.

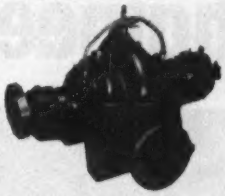
COUPLINGS have *Magic-Grip* quick change bushings for pump and drive shaft. Pin and rubber bushing type usually used. Removal for maintenance is easy.



BALL BEARINGS may be furnished for either oil or grease lubrication. Sleeve bearings also available in larger sizes.

GENEROUS STUFFING BOX LENGTH contains sufficient packing to keep stuffing box maintenance low. Provision is made for sealing water connections or for grease seal if these are required.

DOUBLE SUCTION ENCLOSED IMPELLER is precision turned and carefully balanced to assure vibrationless operation and close wearing ring clearance. Water passages are hand finished to a smooth surface.



STANDARD AND SPECIAL MATERIALS are available for many types of service where government regulations permit. Iron, bronze, stainless steel and combinations of these materials handle both alkaline and acid solutions. Standard sizes carried in stock range from 10 to 7000 gpm with heads as high as 475 feet.



THESE DESIGN AND CONSTRUCTION features of Allis-Chalmers double suction pumps assure long pump life and low maintenance costs. Every A-C double suction pump is carefully tested on the most modern pump testing equipment in the industry.

Complete Pumping Unit

Allis-Chalmers can furnish the complete pumping unit — pump, motor, control and drive — all of coordinated design and manufacture.

Whatever your pumping problem, call your nearby Allis-Chalmers Authorized Distributor or District Office. Or write for Bulletin 08B6146. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3952

Texrope, Magic-Grip, and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Sold . . .
Applied . . .
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by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.



CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

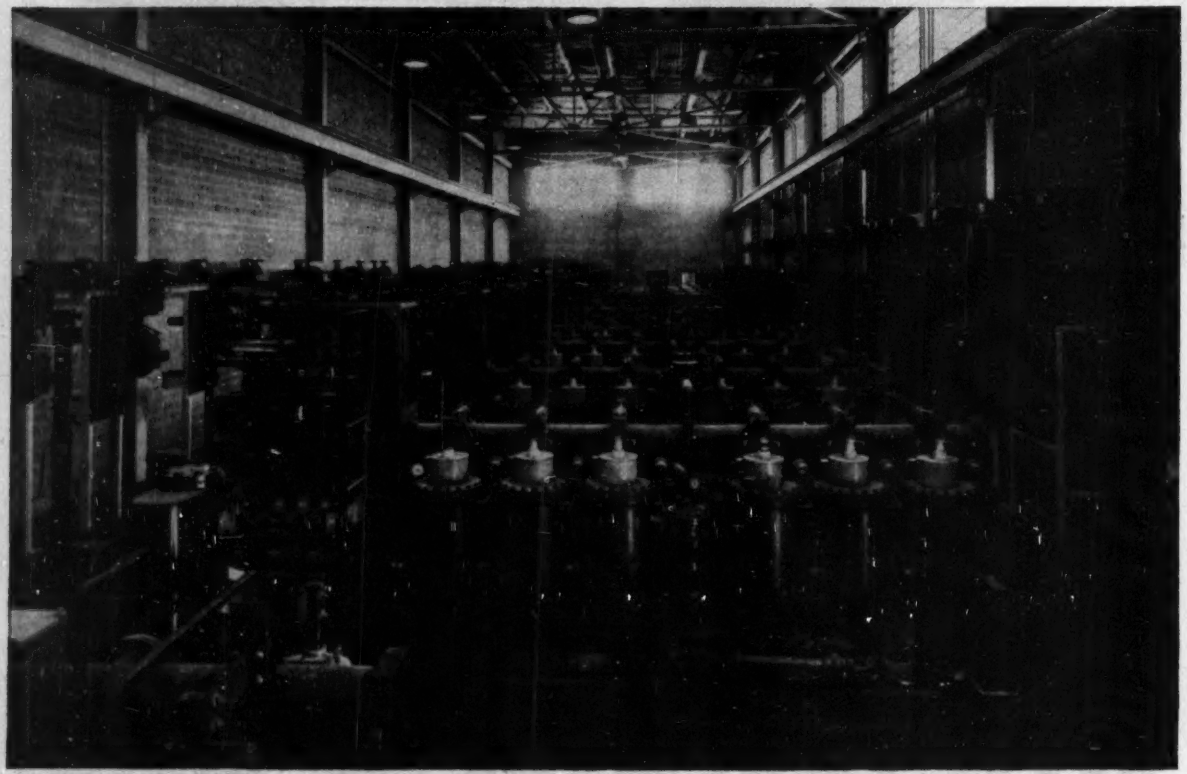


TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

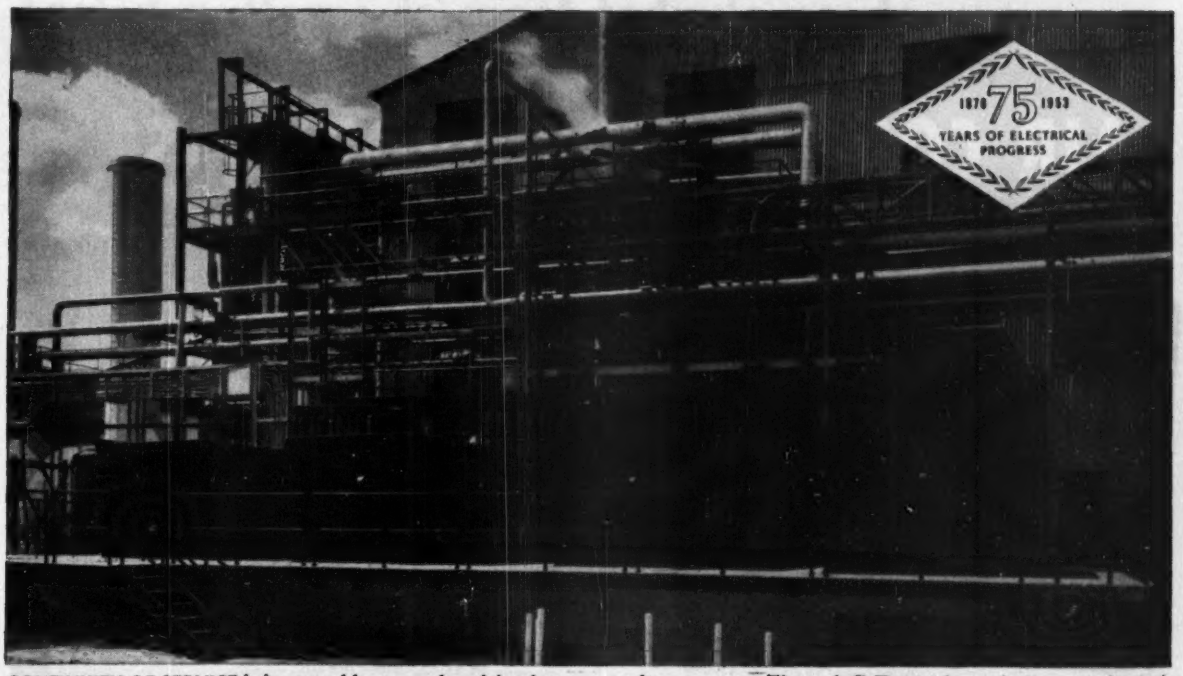


POWER for Diamond Alkali's Gulf Coast chlorine plant is produced economically as a by-product of process steam by three G-E 10,000-kw turbine-generators (one shown). Long, reliable service distinguishes G-E turbines in chemical industry.

Engineered power system is key



COMPLETE RECTIFIER SYSTEM supplied and co-ordinated by General Electric includes (left to right) cathode breakers, excitation cubicles, rectifier tanks, and anode breakers. The 12 rectifiers shown each contain 12 ignitron tanks.



CONTINUITY OF SERVICE is increased by a synchronizing-bus system and secondary selective arrangement to provide low-voltage power. These 4 G-E 13.8-kv switchgear units are grouped outside the turbine building to shorten cable runs.

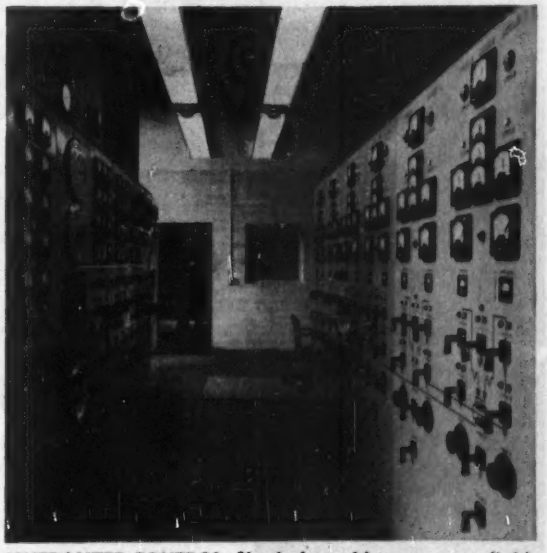
to chlorine plant's high output

Diamond Alkali installs engineered system to help maintain 920-ton daily output

In its Gulf Coast plant near Houston, Texas, Diamond Alkali produces 920 tons per day of caustic soda and liquid chlorine. Because of the large amounts of process steam required—which can also be used to generate power as a by-product—they made use of the help offered by G-E application engineers in applying the equipment needed for an addition to their power system.

Result: G-E turbine-generators develop low cost plant power as a by-product of needed process steam. Additional power is purchased from the local electric utility. G-E metal-clad switchgear units and synchronizing bus system assure power continuity for essential loads. G-E control equipment for power house and rectifier room is grouped together to save manpower and to provide centralized control. A complete G-E rectifier system provides continuous d-c power for cell lines.

Whatever your chemical plant's power-system needs, an experienced G-E application engineer can help you meet them efficiently, economically. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y. 662-40

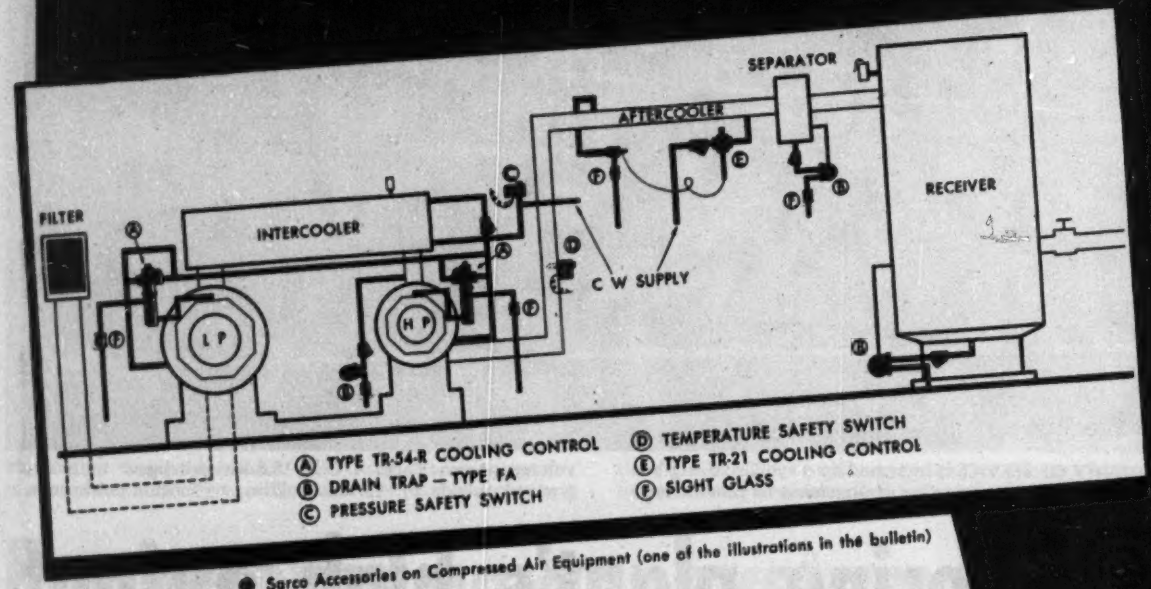


CENTRALIZED CONTROL of both the turbine-generator (left) and of the rectifiers (right) in one location enables one set of operators to supervise the plant's entire power system.

Engineered Electrical Systems for Chemical Plants

GENERAL ELECTRIC

AIR COMPRESSOR PROBLEMS...



● Sarco Accessories on Compressed Air Equipment (one of the illustrations in the bulletin)

write for

TECHNICAL BULLETIN 5-CO...

● Sarco type TR-21 Cooling Control on Air Compressor.





● Sarco type FA Float Trap draining separators.

THIS BULLETIN is designed to pass on to you the experience of compressed air users and of SARCO engineers, in improving equipment operation without excessive outlay.

You will find also simple hook-ups of SARCO cooling controls, and of drip traps which eliminate condensation from intercoolers, aftercoolers, separators and receivers.

SARCO SPECIALTIES FOR COMPRESSED AIR include also: ELECTRIC SAFETY CONTROLS to shut down the compressor or sound an alarm when the temperature or pressure gets too high or too low in the cooling, lubricating or air systems; and a complete range of pipe line strainers.



Practical advice on how to improve operation of your air compressor—free in Bulletin TB-5-CO.

359

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
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Tested patterns to meet today's needs . . .

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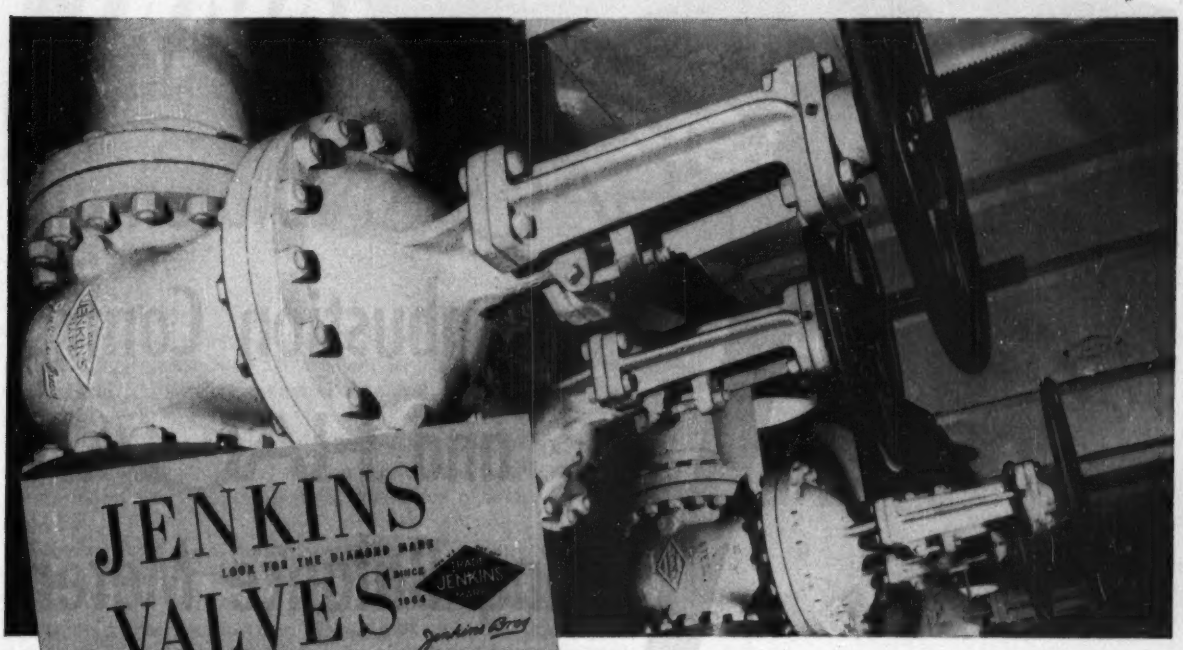
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Mounting pressures and temperatures in power generation and industrial processing call for Cast Steel Valves. For this increasing need, Jenkins offers a wide selection of patterns that have met the test of the toughest services throughout industry.

In these valves, Jenkins provides a wide margin of strength and safety beyond ratings. Special refinements in design extend their service life, assure long, trouble-free performance. Efficiency and low maintenance records measure up to the high standards established for all valves developed by Jenkins Valve *specialists.*

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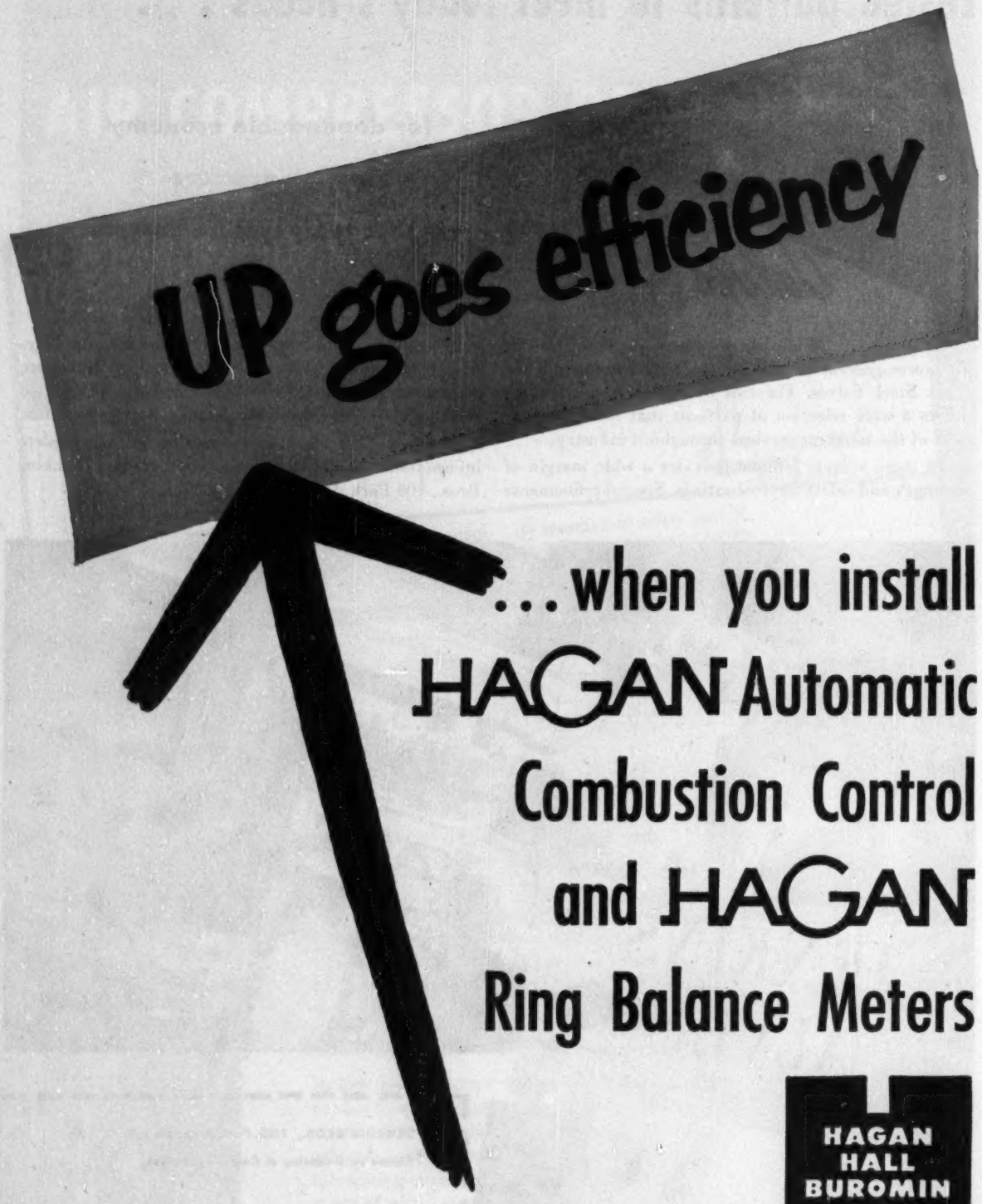
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HAGAN Automatic
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When you install Hagan Automatic Combustion Controls and Hagan Ring Balance Flow Meters, you are certain of accurate and dependable results, low maintenance costs, increased efficiency and economy of operation.

A system of Hagan Automatic Combustion Control is available for your plant, regardless of the number or size of boilers, steam pressure and temperature, or the combination of fuels to be controlled.

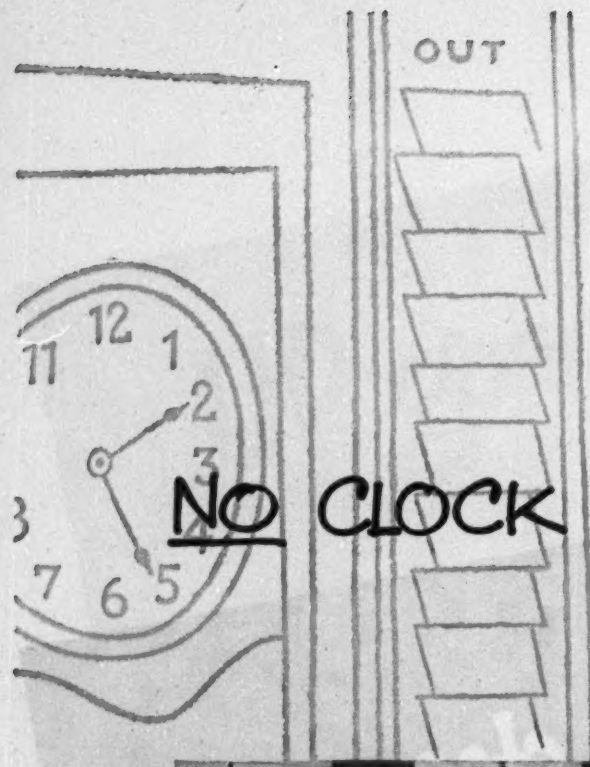
Whether your plant operation requires indications, records, or totalizations of flow, in any combination, there is a Hagan Ring Balance Meter built for the job. Any fluid flow—steam, water, liquid fuels, gases, compressed air—can be measured at any pressure up to 15,000 psig. Automatic temperature and pressure compensation of flow readings are available. Two flow readings can be added or subtracted in a single meter.

For combustion control and metering systems which are versatile, accurate, and durable, install HAGAN. Our engineers will be glad to show you what HAGAN Combustion Controls and HAGAN Ring Balance Meters can do.

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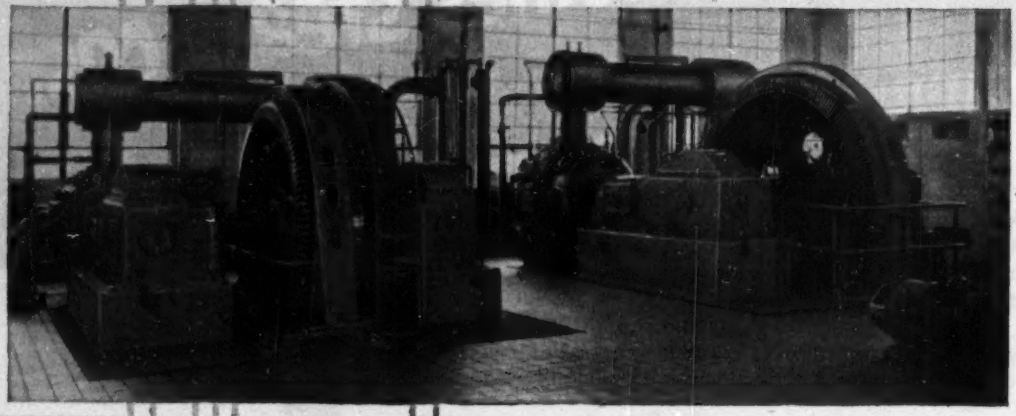
HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
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CONTROL SYSTEMS FOR AUTOMOTIVE AND
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NO CLOCK PUNCHING

for these compressors

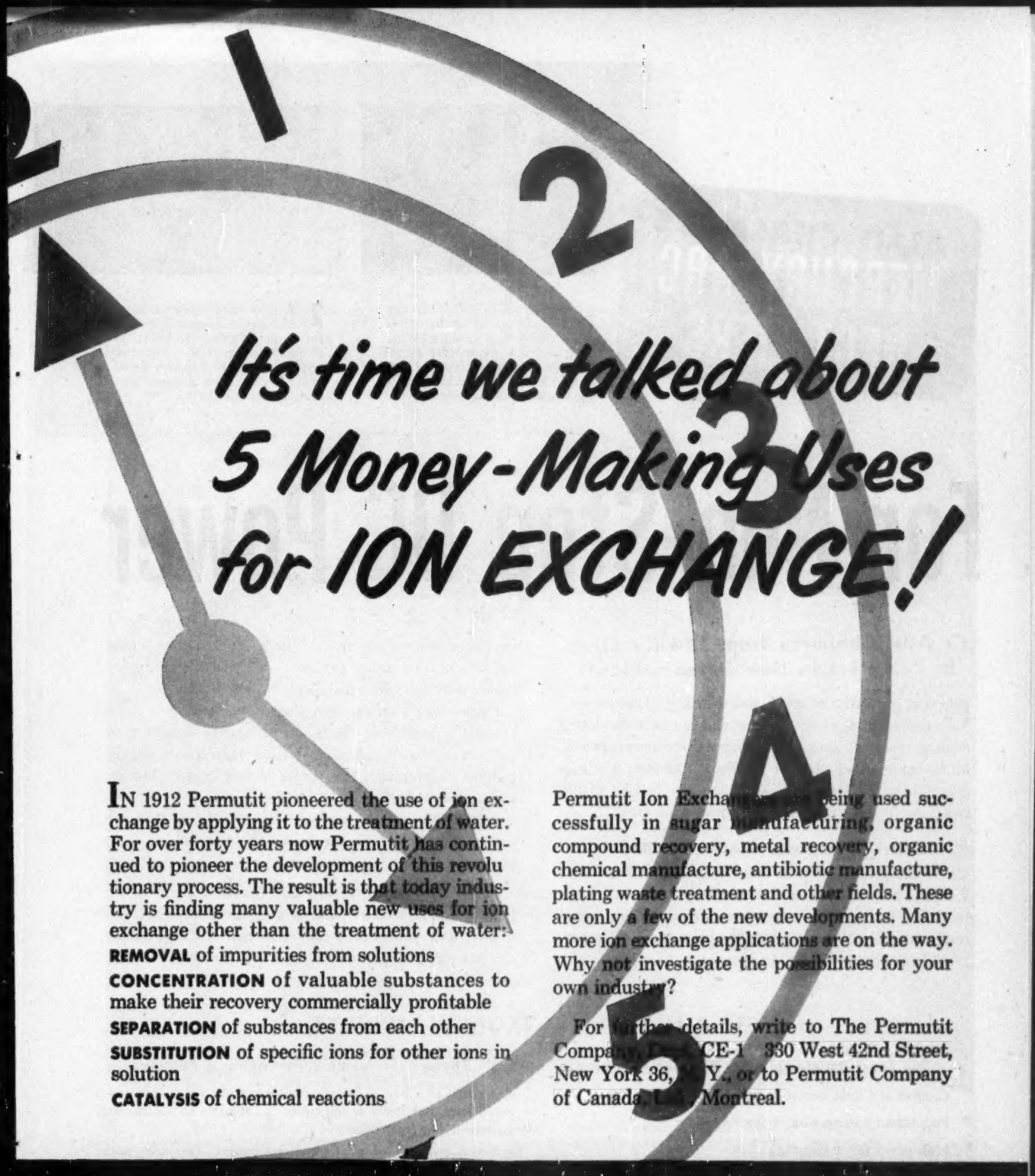


That's right! There's no daily time limit placed on the work output of Chicago Pneumatic Class O-CE Compressors . . . they operate "around the clock" with a minimum of attention. Designed for continuous, year-in, year-out heavy industrial usage, these units are unsurpassed for a dependable air power supply at low cost. Built in sizes up to 2,000 hp, for pressures up to 5,000 lbs., they are available in horizontal, two-stage, water-cooled types with direct-mounted synchronous motor drive.

The Chicago Pneumatic Class O-CE Compressor is equipped with roller bearings, Simplate valves for low power consumption, streamlined air passages to cut down air flow resistance, CP Multi-Step Control for partial load economy, and a CP Intercooler for maximum heat transfer and low water consumption. Ask for Bulletin 726. *Chicago Pneumatic Tool Company, 8 East 44th Street, N. Y. 17, N. Y.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES



It's time we talked about 5 Money-Making Uses for ION EXCHANGE!

IN 1912 Permutit pioneered the use of ion exchange by applying it to the treatment of water. For over forty years now Permutit has continued to pioneer the development of this revolutionary process. The result is that today industry is finding many valuable new uses for ion exchange other than the treatment of water:

REMOVAL of impurities from solutions

CONCENTRATION of valuable substances to make their recovery commercially profitable

SEPARATION of substances from each other

SUBSTITUTION of specific ions for other ions in solution

CATALYSIS of chemical reactions

Permutit Ion Exchange is being used successfully in sugar manufacturing, organic compound recovery, metal recovery, organic chemical manufacture, antibiotic manufacture, plating waste treatment and other fields. These are only a few of the new developments. Many more ion exchange applications are on the way. Why not investigate the possibilities for your own industry?

For further details, write to The Permutit Company, Dept. CE-1, 330 West 42nd Street, New York 36, N. Y., or to Permutit Company of Canada, Ltd., Montreal.

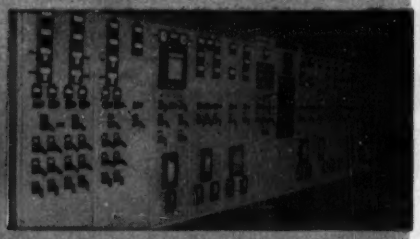
PERMUTIT

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS

MERCURY ARC RECTIFIERS



1. Two of these Allis-Chalmers outdoor oil circuit breakers guard the power entrance to the plant and two more serve as tie breakers. Each breaker is rated 3 cycle, 1200 amps, 161 kv, 7,500,000-kva interrupting capacity.



2. Duplex, tunnel-type main control board is located in rectifier room. It meters and controls all equipment in plant — from the 161-kv oil circuit breakers down to the mercury arc rectifiers and plant power substations.

For Non-Stop DC Power

It's Allis-Chalmers from 154-Kv Lines to Rectifiers in New Defense Plant

UNINTERRUPTED POWER is indispensable in the production of high purity chlorine and caustic soda in two mercury-type cell lines at the new Government-owned, Monsanto-operated plant at Sheffield, Alabama. To help meet this requirement, Allis-Chalmers supplied all of the switching, transforming and rectifying equipment.

Here's How Power Reaches Rectifiers

Under the guardianship of Allis-Chalmers 7,500,000-kva breakers, the 154-kv transmission voltage is stepped down to 13.8 kv by two transformers — each equipped for forced cooling so that either can supply the plant in an emergency.

Backed up by 1,000,000-kva breakers, the main 13.8-kv switchgear splits the electrical system into two plant power and two rectifier power sections — with bus-tie and other special provisions for reliability.

Final distribution for each plant power section is made by unit substations. Each rectifier power section goes through regulating and phase-shifting transformers and six rectifier transformers. The power is then carried through high-speed anode breakers to the 12-tube rectifier assemblies.

Incorporating many exclusive Allis-Chalmers features, the rectifiers operate in two banks of six assemblies each, to supply the two 30,000-amp cell lines.

A-C Engineering Can Serve You

For a complete rectifier plant or a single factory-packaged rectifier unit, you gain by calling in your A-C representative or writing to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3875

WITH ALLIS-CHALMERS *EXCITRON* RECTIFIERS

You Get These 10 Mercury Arc Rectifier Advantages

- Compact and light weight — need no special foundation.
- Push-button starting with no synchronizing.
- High power factor (lagging).
- Low idling loss and high conversion efficiency.
- High momentary overload capacity.
- Immunity to frequent short circuits.
- No major moving parts—provides low maintenance and assures quiet operation.
- No attendance needed during operation.
- Resistant to dust, moisture, fumes.
- Simple construction for long life.

PLUS These 6 Exclusive Allis-Chalmers Features

Fixed excitation anode — doesn't contact mercury and is independent of level, turbulence or impurities . . . requires no adjustment, maintenance or replacement.

Continuous excitation — pilot arc always present. Eliminates need for continuous, synchronized re-ignition. Enables rectifier to ride through severe ac voltage disturbances.

Grid phase control — in cleaner region near anode, where ion density is lowest.

Internal cooling system — high heat transfer with seamless-tube cooling coil located within the rectifier.

Arc-over free tube — insulating entire arc path eliminates danger of arcing-over to tube.

Enamelled anode seals — multi-layer fused vitreous construction provides high-strength seal unaffected by thermal variation.





3. Regulated power for each six assembly rectifier bank is obtained from an auto-regulating transformer (left) supplemented by a 32-step regulator. Two phase shifters (right) are also used for each bank of rectifiers.

4. Rectifier transformers are alternately connected wye and delta. This arrangement plus phase shifters results in each six-transformer bank providing a 36-phase system that minimizes communication circuit interference.

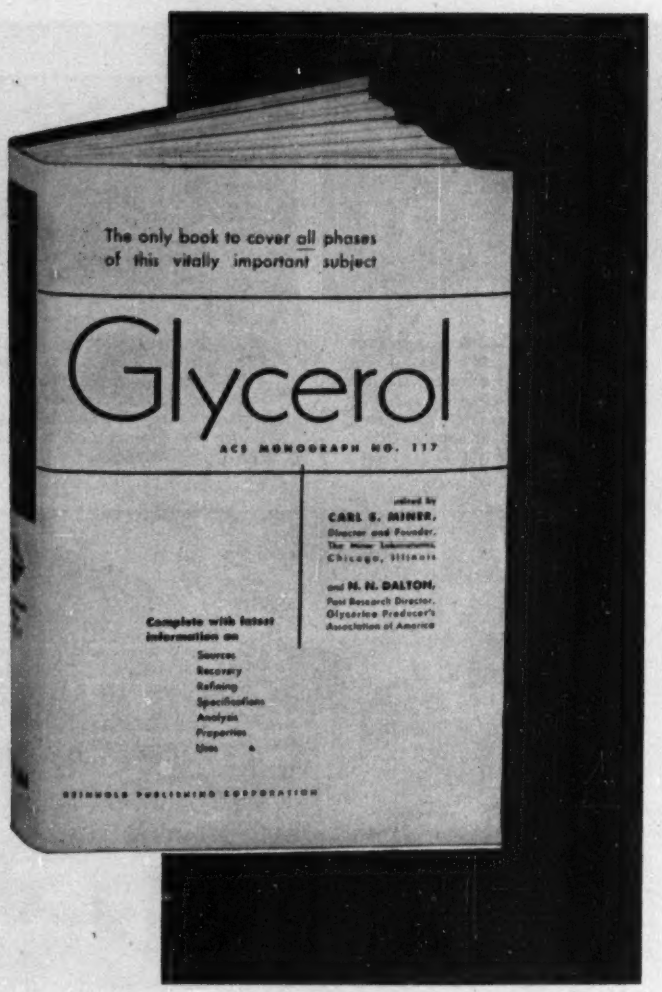


5. Rectifier room, containing twelve 6000-amp, 600-volt, 12-tube, *Excitron*-type rectifiers. Each is a factory-assembled unit, complete with built-on evacuating apparatus, water-to-water heat exchanger, and water circulating, control and protective equipment. (See list at left for six *exclusive features* of Allis-Chalmers *Excitron* rectifiers.) In picture above at left are the anode breakers; at right, the cathode breakers with disconnect switches; and in the center, the excitation compartments containing excitation, phase control, vacuum measuring, and protective equipment.

ALLIS-CHALMERS

Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

First Time Offered!



The ONLY book to tell the COMPLETE story on

Properties
•
Uses
•
Analysis
•
Specifications
•
Sources
•
Recovery
•
Refining

If you use a polyalcohol, this long-awaited reference book is indispensable.

An authentic American Chemical Society Monograph, the new book contains material contributed by the country's ablest producers and refiners of Glycerine, and is edited by Carl S. Miner and N. N. Dalton, nationally known authorities on Glycerine.

The monograph is sponsored by the Glycerine Producers' Association, and includes the latest information on natural and synthetic Glycerine, purification of Glycerine by ion exchange, and new equipment design. Chemists, purchasing agents, and executives will want to keep this new monograph handy for reference. It has easy-to-read tables of the most recent data on standards and specifications, physical and chemical properties.

For a free 10-day examination of the 475-page book, which sells for $12.00, write Reinhold Publishing Corporation, 330 West 42nd Street, New York 36, N. Y., publishers of the monograph.

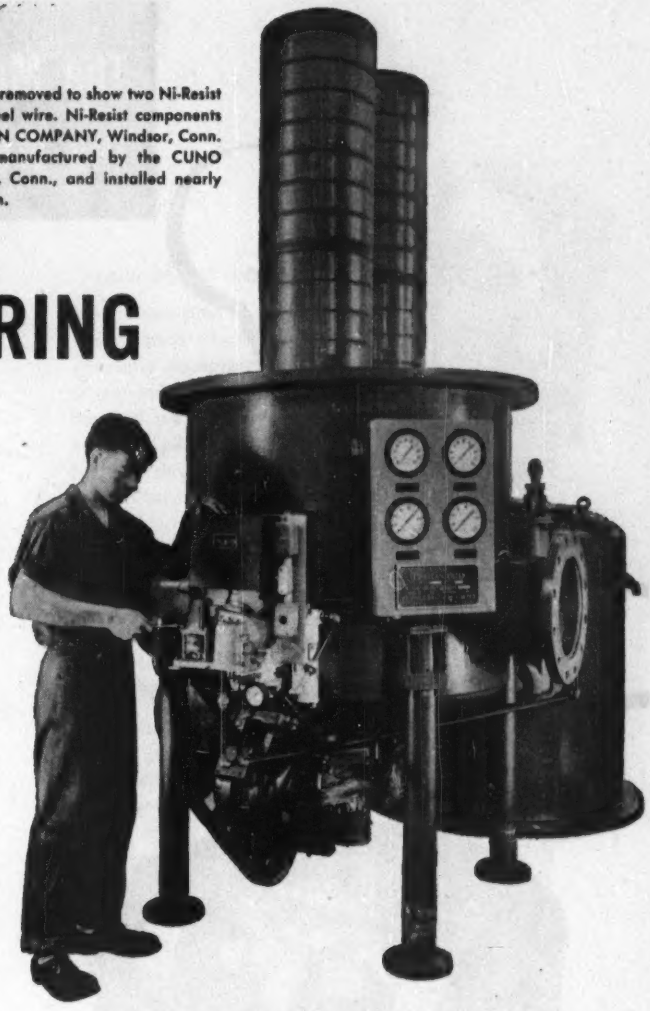
If you need information regarding any specific Glycerine requirement, just write—

GLYCERINE PRODUCERS' ASSOCIATION
295 Madison Avenue, New York 17, N. Y.

CHAPTER HEADINGS

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   —*N. N. Dalton and Joyce C. Kern*
2. Natural Source and Occurrence
   —*Truman M. Godfrey*
3. Methods of Production
   —*Truman M. Godfrey*
4. Recovery and Refining
   —*Truman M. Godfrey*
5. Standards and Specifications
   —*J. B. Segur*
6. Analysis
   —*J. B. Segur*
7. Physical Properties of Glycerol and Its Solutions
   —*J. B. Segur*
8. Chemical Properties and Derivatives of Glycerol
   —*J. B. Segur*
9. Biochemical Use of Glycerol
   —*C. H. Werkman*
10. Physiological Action of Glycerol
    —*Martin E. Hanke*
11. Uses of Glycerine
    —*J. B. Segur*

Cuno-Type FKR filter with bonnet removed to show two Ni-Resist cages wrapped with stainless steel wire. Ni-Resist components were cast by THE TAYLOR & FENN COMPANY, Windsor, Conn. The first Flo-Klean filter unit manufactured by the CUNO ENGINEERING CORP., Meriden, Conn., and installed nearly 14 years ago, is still in operation.



CUNO ENGINEERING uses NI-RESIST

BECAUSE No Other Cast Metal Provides Such a Unique Combination of Useful Engineering Properties

NI-RESIST® is a highly nickel-alloyed iron that provides a unique combination of properties at moderate cost . . .

It resists corrosive attacks of *acids, alkalies* and *salts* and is highly resistant to galling and metal-to-metal wear.

Its wear-resistance, combined with inherent resistance to corrosion, makes Ni-Resist ideal for curbing erosion by liquids and slurries.

To these properties add ready machinability, and it is evident why the vital cylindrical cartridge cores of Cuno Flo-Klean Filters are cast in Ni-Resist.

Several types of Ni-Resist are available to meet a variety of industrial demands. Get full information . . . mail coupon now.

At the present time, nickel is available for the production of Ni-Resist and other alloys containing nickel, for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling. There are authorized producers, from coast to coast, equipped to produce Ni-Resist castings in all common forms and shapes.

THE INTERNATIONAL NICKEL COMPANY, INC.
Dept. 20, 67 Wall Street, New York 5, N. Y.

Please send me booklets entitled, "Engineering Properties and Applications of Ni-Resist," and "Buyers' Guide for Ni-Resist Castings."

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Company_____

Address_____

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THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.



The Mortar and Pestle has been the World's NUMBER ONE mixer

SINCE the days of the ancient Greeks, the *mortar and pestle* has been one of the primary means of preparing materials where intimate blending is vital. The rubbing, smearing action accomplished in a mortar and pestle is the basis for present-day mixing practice . . . but *all* mixing equipment does not produce these desired results. In processing work, true *intensive* mixing is called MULLING, because it can be accomplished only in a muller-type mixer. Here, the components are not merely placed next to each other — but are thoroughly blended together to form a completely uniform, inseparable mass.

Utilizing a special pair of revolving mullers and plows, the SIMPSON MIX-MULLER is designed to duplicate the controlled uniformity which you may now be producing by the mortar and pestle method in your laboratory. Thus, with SIMPSON MIX-MULLERS you can be sure that your production mixing can be just as carefully and accurately controlled as laboratory or pilot plant mixing. Available in 12 basic models, in batch capacities from $\frac{1}{10}$ to 60 cu. ft., SIMPSON MIX-MULLERS may be equipped to meet your processing needs . . . as a reaction vessel . . . for heating or cooling while mixing . . . in stainless or other special metals. Backed by 40 years of specialization in mixing equipment and problems, our engineers will welcome the opportunity of helping you to bring "laboratory control" to your production floor.

DO YOU KNOW WHAT MULLING IS?

Watch the practiced technique of a chemist's mortar and pestle—the intensive rubbing and smearing actions—and basically, THAT'S MULLING!

Mulling with a SIMPSON Mix-Muller utilizes a special pair of revolving mullers and plows mounted on a stationary pan. The mullers are adjustable and are supported by rocker arms. This leaves them free to ride on the material, creating a true mulling action as they revolve. The results are thorough, more rapid blending.

. . . BUT WHY LIMIT ITS USE TO YOUR LABORATORY?

SIMPSON MIX-MULLERS are the answer to any mixing problem involving dry, wetted or pasty materials, and are without equal when it comes to thorough mixing and blending to exacting specifications . . . thanks to the *controlled, proved Mulling Principle of Mixing!*

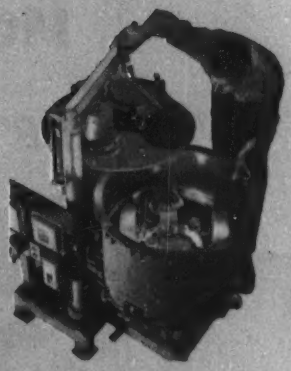
Shown at the right are three typical examples of the way in which Simpson Mix-Mullers are helping scores of widely diversified chemical process plants to do a better, faster mixing job at lower cost. Following is a list of some of the many chemical process applications now being handled with Simpson Mix-Mullers:

ABRASIVES • ADHESIVES • ALUMINUM FLUX
ARTIFICIAL STONE • ASBESTOS INSULATORS
ASPHALT PRODUCTS • BATTERY PASTE
CARBON PRODUCTS • CATALYSTS • CRUCIBLES
DETERGENTS • DYE AND BLEACHING
POWDERS • GLASS BATCHING • GREASE
GRAPHITE • INSECTICIDES • NICKEL
OXIDE • PAPER COATINGS
PHARMACEUTICALS • PLASTER
PLASTICS • PUTTY • REFRACTORIES
ROOFING GRANULES • RUBBER
COMPOUNDS • SOAP • SYNTHETIC
FUELS • TITANIUM DIOXIDE
WATER TREATMENT COMPOUNDS
WELDING ROD ELECTRODES
WOOD FIBERS • ZIRCONIA

USE OUR LABORATORY SERVICE

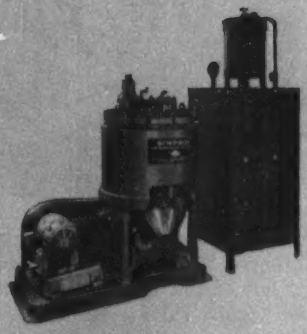
We maintain a completely equipped modern testing laboratory for determining the results of mixing different materials in Simpson Mix-Mullers. A confidential test in our laboratory will prove what a Mix-Muller will do for you. Write for further details.





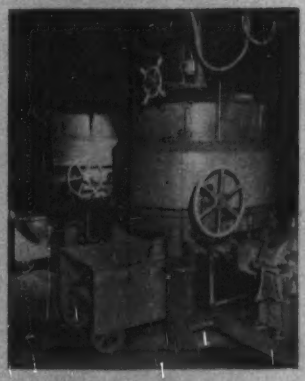
PILOT PLANT WORK

View shows a laboratory size Simpson Mix-Muller, specially equipped for mixing under vacuum and heat, in pre-testing trial batches in pilot plant work for electrical porcelain production.



HOT OIL CIRCULATION

This versatile No. 00 Mix-Muller prepares an infinitely variable number of different mixes under widely varied conditions. Equipped for vacuum and pressure, and jacketed for hot oil circulation.



WATER-COOLED

These No. 1½ Simpson Mix-Mullers are equipped with jacketed sides and bottom for full water circulation, to control heat produced by chemical reaction in mixing of storage battery plate pastes.

SIMPSON *MIX-MULLER*® DIVISION

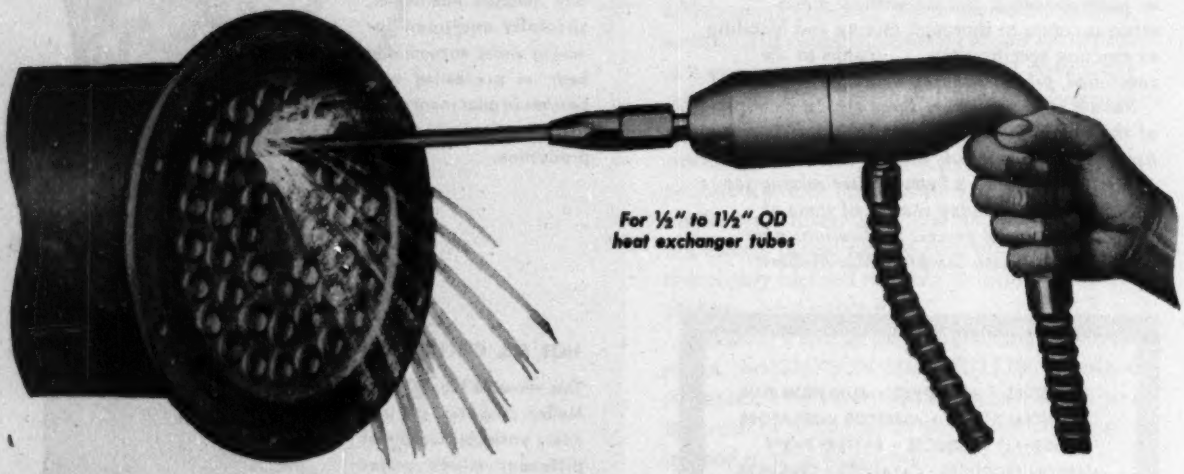
NATIONAL ENGINEERING CO., 604 Machinery Hall Bldg., Chicago 6, Ill.
(Not Inc.)



NEW WILSON

MODEL PGX CLEANER

out-performs ordinary types 10 to 1



Need increased output from your heat exchangers? Wilson brings you a complete line of fast-acting tube cleaners —the popular PG for ⅜" to 1", the TP-301 for up to 2½" . . . and *now* for intermediate sizes, ½" to 1½", the *new* Model PGX Tube Cleaner.

The new PGX out-performs internal type cleaners 10 to 1. It is a positive drive (not geared down) high speed, hollow rotary shaft, air-driven scavenger type cleaner. It washes out the tube and debris while it cleans, and, at the same time, keeps the drill bit cool. There's no worry about jammed, burned out bits, no need for special preparation.

Wilson Model PGX obtains maximum power at 90 psi using 75 cfm at approximately 3,500 rpm. In many cases it will perform satisfactorily at 50 psi. It is suitable for horizontal or vertical applications . . . requires *only one man* to operate. Hollow drill shafts are available in one piece up to 20 feet. Shorter lengths can be coupled by means of taper threads.

Don't struggle along with improvised tools. Use the new PGX Cleaner to minimize downtime. Put fouled equipment back on stream in a hurry.

Plus Features

- Weighs only 8 lb
- Only 11" overall
- Well balanced . . . with a "man-sized" grip
- Low in cost
- Large scavenger volume
- Fingertip air control
- Simple internal rotary seal
- Operates on 50 psi, if necessary
- Shafts and cutter bits interchangeable with existing Wilson PG and TP-301 Cleaners.

TW 829

Use the MODEL PGX CLEANER on this equipment

Water Heaters
Gas Coolers
Glycerine Evaporators
Fuel Oil Heaters
Polymerization Units
Humidifier Tubes
Small Transfer Lines
Miscellaneous Heaters
Miscellaneous Condensers
Miscellaneous Evaporators

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Generating Stations
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How a pharmaceutical plant

Simplified Installation and Operation of Condensers

with "Delanium" Carbon Cubic Exchangers

HOFFMANN-LAROCHE, world-famous producers of pharmaceuticals, selected "Delanium" Carbon Cubic Heat Exchangers for their important condenser installations. Here's why:

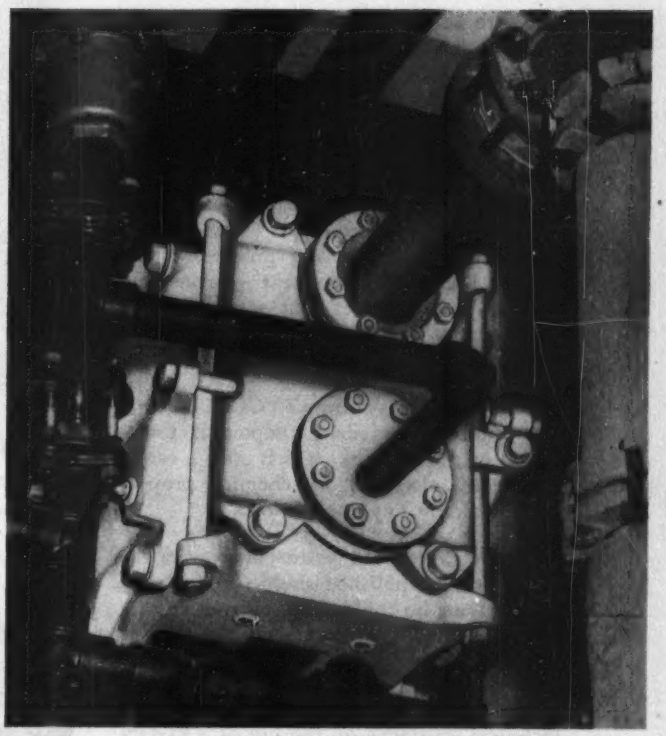
First, the "Delanium" exchangers withstand highly corrosive process vapors—HCl in several applications and halogenated ketones in others. Actually, the dense, impervious "Delanium" graphite resists attack of most acids, alkalies, salt solutions and organic chemicals.

Also, these units are exceptionally compact—50 sq. ft. of high heat transfer surface in a 15 inch cube. In fact, "Delanium" units require only about one-tenth the space of shell-tube type condensers, thus permitting installation close to other equipment in the system and saving long runs of costly corrosion-proof pipe. Only simple supporting ceiling hangers are needed.

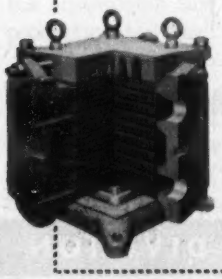
Furthermore, the design permits operation of the units under vacuum higher than 100 microns. In all installations, these units provide for complete drainage, subcooling the condensate, and zero hold-up of the product.

Write for this fact-filled bulletin. It gives detailed design specifications and operating characteristics.





This Hoffmann-LaRoche installation is an example of how the compact "Delanium" exchanger can be placed at the most efficient location—even where space is limited.



The simplicity of the "Delanium" design provides an exchanger with exceptional adaptability to widely different processes. It also is being successfully used—

- as a Heater
- as a Cooler
- as an Evaporator
- as a Crystallizer
- as a Reaction Vessel

... with all *these operating advantages:*—

HIGH PRESSURES—Graphite cube clamped in compression by heavy castings permit operating to 100 psi.

HIGH HEAT TRANSFER—Accurately designed cube insures high heat exchange.

LOW MAINTENANCE—All headers easily removed for inspection, cleaning. No fragile tube bundles.

HIGH CORROSION RESISTANCE—Corrosives contact only "Delanium" graphite.

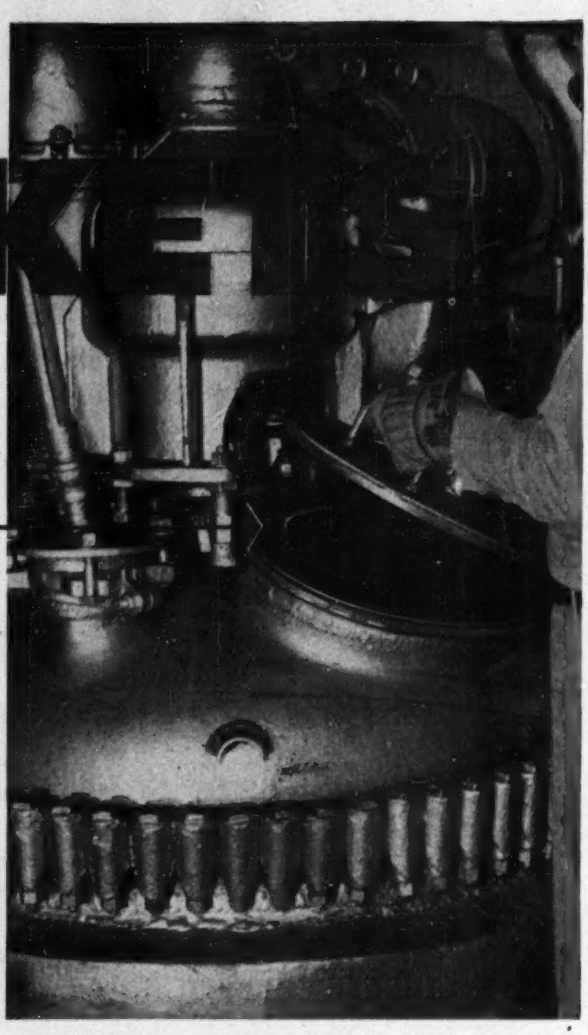
"Delanium"
Trade Mark

Delanium Carbon Corporation
18 East 48th St., New York 17, N. Y.

In England: Powell Duffryn Carbon Products Ltd. Hayes, Middlesex, England

Tough GASKETS

FOR TOUGH JOBS ARE MADE WITH TYGON



TYGON GASKET — in service against 85% acetic acid, at 160°-175°F lasts over a year compared to a few weeks' service from rubber. Photo courtesy Hoffman-LaRoche Inc.

One sure answer to tough gasketing problems is the versatile corrosion-resistant TYGON family of plastic compounds. For, TYGON not only resists acids, alkalies, oils, greases, some solvents, and water — but, is strong, resilient, abrasion-resistant and light in weight. TYGON is also impermeable, non-contaminating and non-oxidizing. TYGON can be used for virtually any gasketing job in chemical processing and general industrial equipment — wherever positive, enduring seals or separators are required. For food and beverage uses, special non-toxic compounds are also available.

For service as gasketing, TYGON is made in a number of standard compounds, translucent or glossy black, which offer a range of physical, electrical, and chemical properties for almost any application.

TYGON gaskets can be die-cut from calendered or press-polished sheets ($\frac{1}{64}$" to $\frac{1}{2}$" thick); can be molded in practically any size or shape; or, can be extruded as tubing, solid cord, or channel in continuous lengths.

Write today, for further information and technical assistance on the use of TYGON as gasketing. Ask also about the other uses of this versatile plastic that can help you combat corrosion.

TYGON TUBING



fully flexible, glass-clear, mirror-smooth for safe, speedy transmission of liquids, gases and semi-solids.

TYGON TANK LINING



long lasting, heavy duty sheet TYGON to withstand virtually all chemicals.

TYGON PAINT



quickly applied, fast drying protection against corrosive fumes and spillage.

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THE VERSATILE CORROSION-RESISTANT PLASTIC

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344-C

PLASTICS AND SYNTHETICS DIVISION

THE Chementator®

Prepared under the direction of Joseph A. O'Connor, News Editor

• A brace of new producers will make polyethylene. Dow will build a plant at Freeport, Tex., and Spencer Chemical will erect one at Orange, Tex. Spencer will turn out 45 million pounds per year. Both will use the ICI polyethylene process.

• Hooker Electrochemical, spending $22 million this year for expansion, will market new products including polyester resins, herbicides and fluorine chemicals.

• Stepping up output of synthetic glycerine, Shell Chemical at Houston, Tex., will build a $9 million plant.

New phosphate producer for Utah

American Smelting & Refining has teamed with Stauffer Chemical and Kennecott Copper to form a new company, Western Phosphates, Inc., which will build and operate a plant near Garfield, Utah, for the production of triple superphosphate, ammonium phosphate and fertilizer-grade phosphoric acid.

The new plant will use up to 250 tons per day of sulfuric acid. Garfield Chemical & Manufacturing Corp. will produce the acid.

Stauffer has a 50 percent interest in the new company. American Smelting & Refining and Kennecott each have a 25 percent interest.

Epichlorohydrin for epoxy resins

Output of the new plant that Shell Chemical has just put on stream at Houston will suffice to meet present and future U.S. demand for epichlorohydrin. So prophesies President Jan Oostermeyer of Shell Chemical.

A major component of epoxy resins, epichlorohydrin is also a chemical intermediate and is used in adhesives and as a stabilizer in insecticides.

"Epichlorohydrin had been so little used before the war," Oostermeyer recalls, "that many people thought we had overbuilt when we constructed our first plant in 1947. But the expansion of the market has necessitated this current threefold increase in our production facilities."

The manufacturing process has been improved since the first plant was built. Raw material for epichlorohydrin is allyl chloride of which Shell is the major producer. The allyl chloride is made from propylene, which comes from oil refining operations. Allyl chloride plays an important role in Shell's over-all glycerine production at Houston.

Part of the new epichlorohydrin production will be tied in with the expansion of Shell Chemical's facilities for manufacturing epoxy resins. These resins are currently tight and will remain so until next fall when Shell Chemical brings in its new bis-phenol and epoxy resin plants at Houston. Bis-phenol is produced from acetone and phenol, both petroleum derivatives. The epoxy resin plant will be the world's largest.

Crane to become large producer of titanium

Seeking a location for a plant to cost close to $20 million, Crane Co plans to produce 6,000 tons per year of titanium. One 250-acre site near Nashville, which required action by the Tennessee state legislature before Crane could option it, is being considered.

Crane holds other options also, has been nosing around the Middlewest for likely spots. But no option will be exercised until financing plans, which involve the government, are completed.

Though most of the titanium will go to the government at first, industrial uses will be explored. And if the price comes down far enough, industry may even get titanium valves.

At present Crane plans to use a modified Kroll process in the large plant as it has in its pilot unit. Advent of an electrolytic process in the meantime might change this plan, however.

Record outlay for research in textiles

A whopping $30 million, the most ever, was spent in the textile industry during 1952 for research and development. The campaign to develop new synthetic fibers and the counteroffensive by makers of older synthetics and natural fibers account for this unprecedented outlay.

The $30 million is double research expenditures

in the textile industry for 1946. In percentage of sales being spent for research, it represents an increase from 0.14 percent in 1947 to about 0.20 percent last year.

In addition to what textile mills spent for research, the $30 million estimate includes expenditures by government agencies. It also includes the total research income of textile schools and independent laboratories engaged in textile research ($1 million).

Expenditures for the benefit of the textile industry by fiber producers, machinery manufacturers and suppliers to the industry would swell the total. Even so, it's not as high as the percentage of the sales dollar spent for research in other industries.

Use of synthetics, mill productivity and U.S. population are each increasing at a rate of 2 percent a year. Productivity could be increased far more with added research.

High expenditures also were made last year by the textile industry for textile machinery, auxiliary equipment and supplies. These expenditures totaled more than in any year except 1951. And if sales forecasts hold up, dollar volume of these mill purchases may set a new record in 1953.

Increased production of synthetics will become more and more important to the textile industry during 1953. But the use of wool, like cotton, also will increase in the next 10 years.

In 10 years it's expected that: (1) fiber consumption will rise from less than 7 billion pounds to 8 billion; (2) synthetics will account for about 3.2 billion pounds or 40 percent of the total; and (3) U.S. market potential will increase with a population rise of some 20 million customers.

These increases can be more than taken care of by present mills if they keep up with advancing technology through research.

Rubber industry: fat market for chemicals

GOOD CUSTOMER—The rubber industry is a big and growing customer for chemicals. Each year, the rubber industry purchases pigments and chemicals valued at $450 million. That's the estimate V. L. Peterson of Goodyear gave CCDA members in Cleveland recently.

The rubber industry is big and growing. The top 10 companies do an annual business of dollar sales exceeding $4 billion. And about 60 percent of the sales dollar is spent for raw materials, supplies and equipment.

Rubber companies produce a tremendous array of products. Tires, a major product, shape up like this: in 1940 about 60 million tires of all types were produced; in 1952 production reached 94 million; and in 1960 tire output is expected to climb to 127 million.

In addition, rubber manufacturers are engaged in operations closely allied to chemical processing. They produce polyvinyl chloride resins and latices, styrene-butadiene copolymer resins and latices, Buna-N rubbers, sponge and cellular products made of polymers other than rubber, accelerators, antioxidants and other chemicals. For the chemical industry, this market within a market provides an outlet for chemical intermediates, plasticizers, wetting and dispersing agents, catalysts and a host of other chemicals.

Nor has the rubber industry reached its peak. In 1941, it used rubber at the rate of 780,000 long tons per year. The total for 1952 was 1.23 million long tons. Rubber consumption for 1962 is estimated at 1.6 million tons.

In the decade from 1941, total industrial production increased about 37 percent, while the rubber industry increased almost 60 percent. Nor is the industry over the hill yet. As Peterson points out, "Our business increased 58 percent from 1941 to 1952 and we estimate a further increase of approximately a third in the next 10 years."

CHEMICALS CONSUMED—That $450 million a year spent by the rubber industry goes for a variety of chemical products. These range from antioxidants, accelerators and retarders, fatty acids and their derivatives to plasticizers and solvents. Also included: vulcanizing agents, activators, reinforcing agents, fillers, wetting agents, color pigments, waxes, cements and adhesives.

These chemicals are added to raw rubber by the compounder to get a compound that can be processed in plant equipment, to impart required properties to the finished product and to make possible production at a cost that will insure a profit.

ANTIOXIDANTS—Used to retard oxidation, degradation due to heat and light, flex cracking and atmospheric cracking, antioxidants are of two classes, staining and non-staining. A staining antioxidant tends to migrate and will discolor light stocks.

Typical of a generally useful antioxidant of the staining type is phenyl beta naphthylamine. Non-staining antioxidants are exemplified by the styrenated phenols and other phenolic derivatives. Total antioxidant use is about 60 million pounds per year.

ACCELERATORS AND RETARDERS—An accelerator speeds the vulcanization of rubber, reducing the time for cure. A retarder prevents the acceleration from taking effect until curing temperatures are encountered, thus avoiding scorched stock.

Certain organic acids such as benzoic, salicylic, phthalic and phenols may be used as retarders.

Accelerators are generally organic. Some inorganic compounds such as litharge, zinc oxide, lime and magnesia have been used as accelerators, but their use now is almost exclusively as activators for organic accelerators. Accelerators are usually classed as accelerators or ultra-accelerators, the ultras promoting extremely fast cures.

(*Continued on page 110*)

3 Packages of chemical feeding proficiency





%Proportioneers% Heavy Duty Chem-O-Feeder is built in three basic models, having one, two, or three measuring chambers, each of which is adjustable independently. These easy-to-install, easy-to-operate chemical proportioning pumps are specially engineered to provide the utmost in dependability under all operating conditions.

Whatever your chemical feeding problem, %Proportioneers% equipment and engineering knowledge are ready to help. The %Proportioneers% line includes the widest range of chemical feeding and water treating equipment: manually adjustable, constant-rate feeders; Pur-O-Cel Diatomite Filters; flow-proportional, automatic feeders. Consult your telephone directory for our nearest representative or write direct for new Bulletin 1225-1.



HEAVY DUTY CHEM-O-FEEDER SPECIFICATIONS:

- Feeding rates 0.2 to 57 gallons per hour.
- Discharge pressures to 100 lbs. per square inch.
- Suction lifts up to 20 ft.
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- Famous "See-Thru" molded plastic measuring chamber suitable for feeding most treating chemicals.
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- Drive Motor — standard fractional horsepower general purpose.

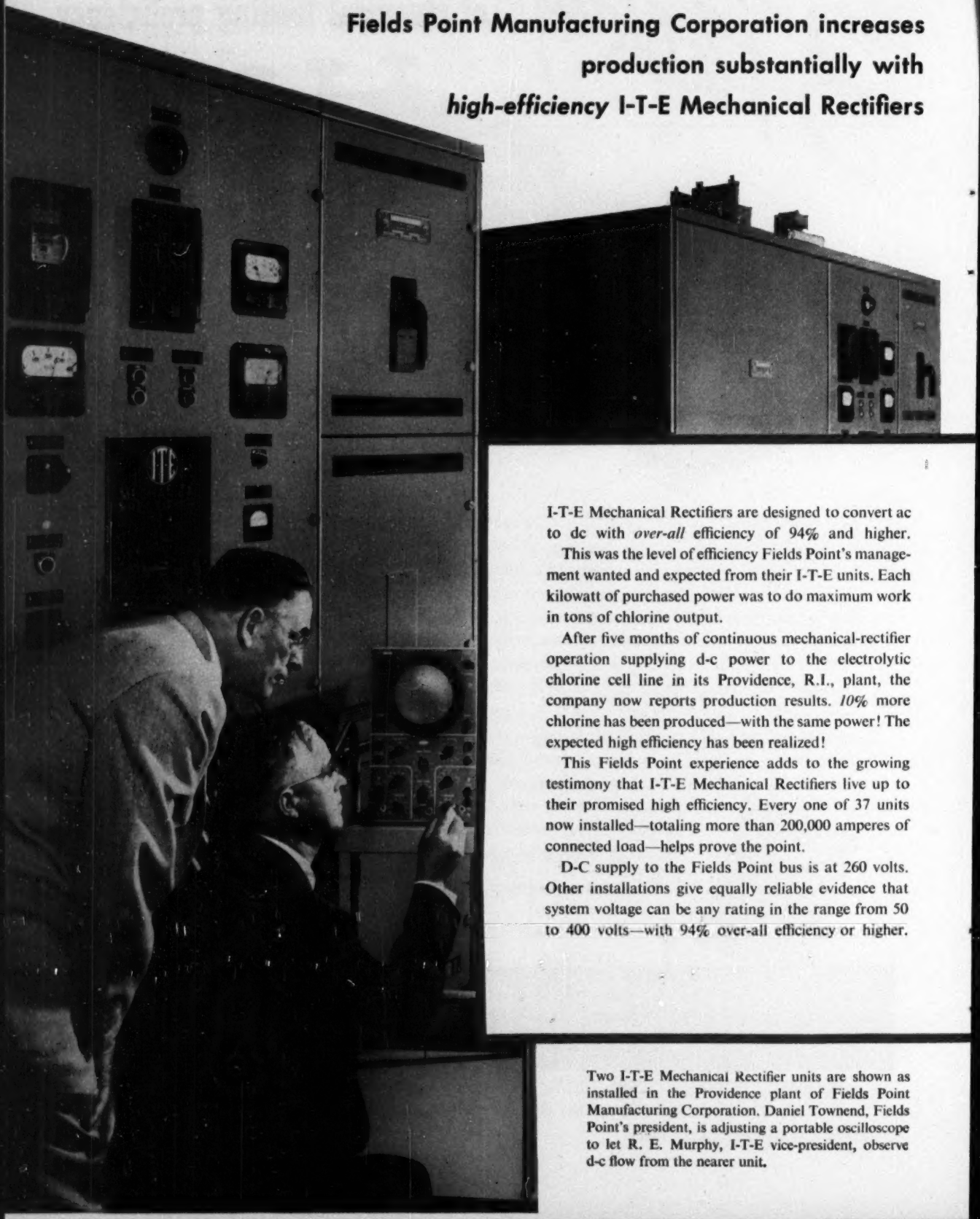
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Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

The same incoming power

Fields Point Manufacturing Corporation increases production substantially with *high-efficiency* I-T-E Mechanical Rectifiers



I-T-E Mechanical Rectifiers are designed to convert ac to dc with *over-all* efficiency of 94% and higher.

This was the level of efficiency Fields Point's management wanted and expected from their I-T-E units. Each kilowatt of purchased power was to do maximum work in tons of chlorine output.

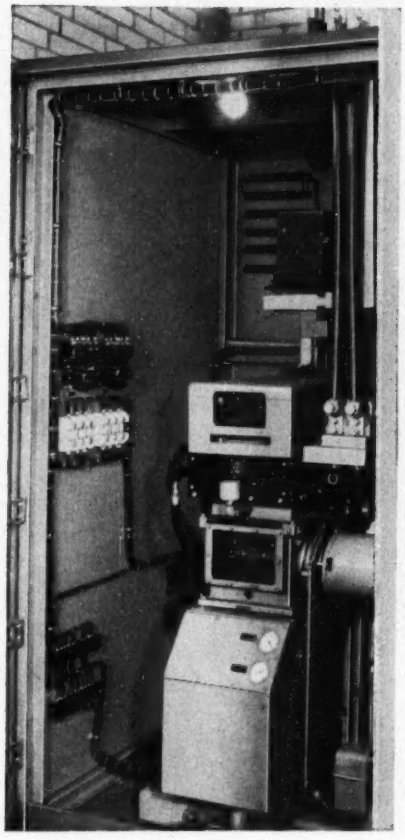
After five months of continuous mechanical-rectifier operation supplying d-c power to the electrolytic chlorine cell line in its Providence, R.I., plant, the company now reports production results. *10%* more chlorine has been produced—with the same power! The expected high efficiency has been realized!

This Fields Point experience adds to the growing testimony that I-T-E Mechanical Rectifiers live up to their promised high efficiency. Every one of 37 units now installed—totaling more than 200,000 amperes of connected load—helps prove the point.

D-C supply to the Fields Point bus is at 260 volts. Other installations give equally reliable evidence that system voltage can be any rating in the range from 50 to 400 volts—with 94% over-all efficiency or higher.

Two I-T-E Mechanical Rectifier units are shown as installed in the Providence plant of Fields Point Manufacturing Corporation. Daniel Townend, Fields Point's president, is adjusting a portable oscilloscope to let R. E. Murphy, I-T-E vice-president, observe d-c flow from the nearer unit.

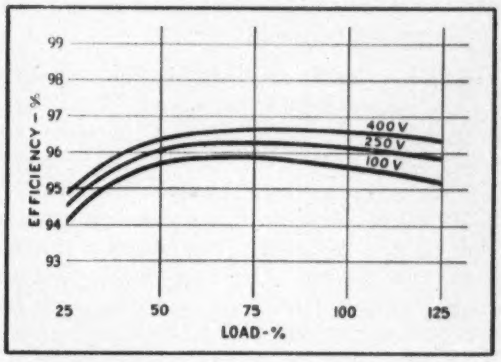
but 10% more chlorine!



One of the two contact mechanisms in the Fields Point installation of I-T-E Mechanical Rectifiers. Each Rectifier is a standard I-T-E unit with design rating of 5000 d-c amperes.

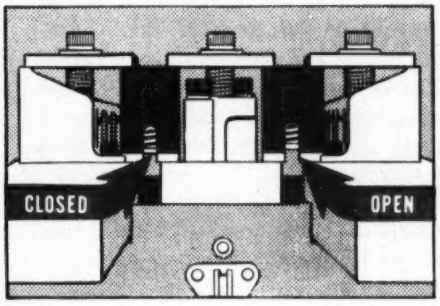
HIGH EFFICIENCY THROUGHOUT LOAD RANGE

During continuous operation at the Fields Point plant, load has remained at or very near 100%. Should load vary at any time to as low as 25% or up to 125%, over-all conversion efficiency will still be high. The LOAD-EFFICIENCY curve below is characteristic of I-T-E Mechanical Rectifier performance, and represents a principal advantage: flexibility for plant production schedules while getting the most out of a-c power purchased.



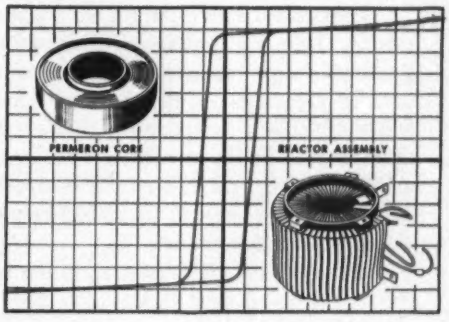
HERE'S WHY

Here are two basic reasons why I-T-E Mechanical Rectifier users get 94 kw (and more) of d-c power for every 100 kw of a-c power they buy:



Solid silver contacts held closed by powerful springs, give highest conductivity between a-c and d-c networks.

Sparkless low-loss commutation is obtained by interposing a Permeron*-core reactor between a-c supply and contact mechanism. This provides a brief period during which current in a contact is zero, allowing sufficient time for sparkless contact closing or opening.



**I-T-E's special saturable core material. Typical Permeron magnetization curve is shown above.*

Get the facts—If you are planning new or expanded a-c to d-c conversion facilities, it will pay you to investigate high-efficiency I-T-E Mechanical Rectifiers. They increase production or cut power bills in many kinds of applications—electrolytic chemical production, metal refining, motor load. Write for details.

BULLETIN 5106—covers theory, design, construction, standard arrangements.

BULLETIN 5204—gives details of I-T-E's special magnetic core material, *Permeron.*

BULLETIN 5205—presents engineering explanation of high efficiency provided by I-T-E Mechanical Rectifiers.

I-T-E

MECHANICAL RECTIFIERS

I-T-E CIRCUIT BREAKER CO.•Rectifier Division•19th and Hamilton Streets, Philadelphia 30, Pa.

EPD—Canadian Mfg. and Sales: Eastern Power Devices, Ltd. Toronto

Guanidines and aldehyde amines are examples of moderately fast accelerators. They are used to the extent of 6½ to 7 million pounds per year. Mercapto benzo thiazole is faster than the guanidines but slower than the ultras. The industry consumes 15 to 20 million pounds per year. Common ultra-accelerators are the zinc and selenium salts of ethyl and methyl dithiocarbamate and ethyl and methyl thiuram disulfides. These total about 7 million pounds per year.

Sulfenamides are examples of extremely safe accelerators at processing temperatures that exhibit powerful effect at curing temperatures.

Accelerators do not perform solely the function of acceleration. Some ultras also act as vulcanizing agents. Many have antioxidant characteristics.

The total accelerator requirement is about 70 million pounds per year.

FATTY ACIDS—Used primarily for activation, fatty acids and their derivatives also have other functions in processing rubber compounds. Soaps are often used to prevent uncured stocks from sticking together or to prevent sticking in the mold. Amounts of fatty acid required in rubber compounding vary drastically. At a guess, Peterson puts this market in the neighborhood of 25 to 30 million pounds a year.

These fatty acids are often used with zinc oxide for activation. The acid and oxide presumably form a rubber-soluble zinc soap that reacts with the accelerator. Zinc oxide also acts as a reinforcing filler and is used as a white pigment. It's estimated that the industry uses about 80,000 tons of zinc oxide each year.

PLASTICIZERS—The rubber industry uses many different plasticizers. They may be derived from petroleum, coal tar or vegetable oils; they may be naval stores products or compounds of the ester type.

Plastictizers soften the rubber compound for easier mixing, help in dispersing other compounding ingredients, impart required processing characteristics or specific properties in the finished product, such as flexibility at low temperature, and some may impart building tack to the raw stock. Many plasticizers have a decided effect on the curing characteristics of the stock, hence a change in plasticizer may require a drastic change in formulation.

Among plasticizers common in the rubber industry are medium and light process oils, pine tars and oils, rosin oils and phthalate esters. Total plasticizer needs of the rubber industry, excluding reclaimed oils, probably exceed 30 million gallons annually.

SOLVENTS—Both aromatic and aliphatic solvents are used by the rubber industry in the manufacture of cements and to freshen and tackify uncured surfaces during manufacturing operations. Prime requirements for such solvents are an evaporation rate that insures their complete removal before the product reaches the curing stage and, in addition, complete absence of greasy residue on evaporation. Unless a solvent meets these requirements it is apt to cause blistering of stock during curing or poor adhesion with resultant ply separation in the finished product.

The solvent used in largest volume is "rubber solvent," essentially a gasoline fraction. All told, the rubber industry uses about 30 million gallons of solvents each year.

DOLLAR VOLUME—Thus the rubber industry each year requires 130 million pounds of antioxidants and accelerators valued at $78 million, 30 million pounds of fatty acids at $2.5 million, 160 million pounds of zinc oxide at $23 million, 30 million gallons of plasticizers at $8 million and 30 million gallons of solvents at $4.5 million. Even so, this accounts for only $115 million of the $450 million spent for chemicals and pigments.

Carbon black, largest single item in the chemical and pigment category that the rubber industry uses, accounts for about $80 million of the remainder. Carbon black is used to the extent of 35 to 40 percent of the total rubber hydrocarbon consumed. Annual consumption is more than 1 billion pounds.

FUTURE NEEDS—What chemicals will the rubber industry be seeking in the years ahead? "We will need," declares Peterson, "accelerators, antioxidants, vulcanizing agents, which will allow us to mix super-abrasion carbon blacks that haven't been developed yet. We will need a low-cost process for producing butadiene or a substitute monomer for use in the production of GR-S. We will need a white or light-colored pigment with higher reinforcing characteristics than anything on the market today. We will need a new chemical fiber better than rayon and nylon for tire cord at a lower cost."

New way to get highly reactive sodium

Highly reactive sodium, at its maximum energy level, and in a form that can be easily handled and easily controlled, can now be produced by coating inert solids such as salt, soda ash, carbon, alumina and sand with atomic layers of metallic sodium. National Distillers Chemical Co. developed this new method for getting high surface sodium.

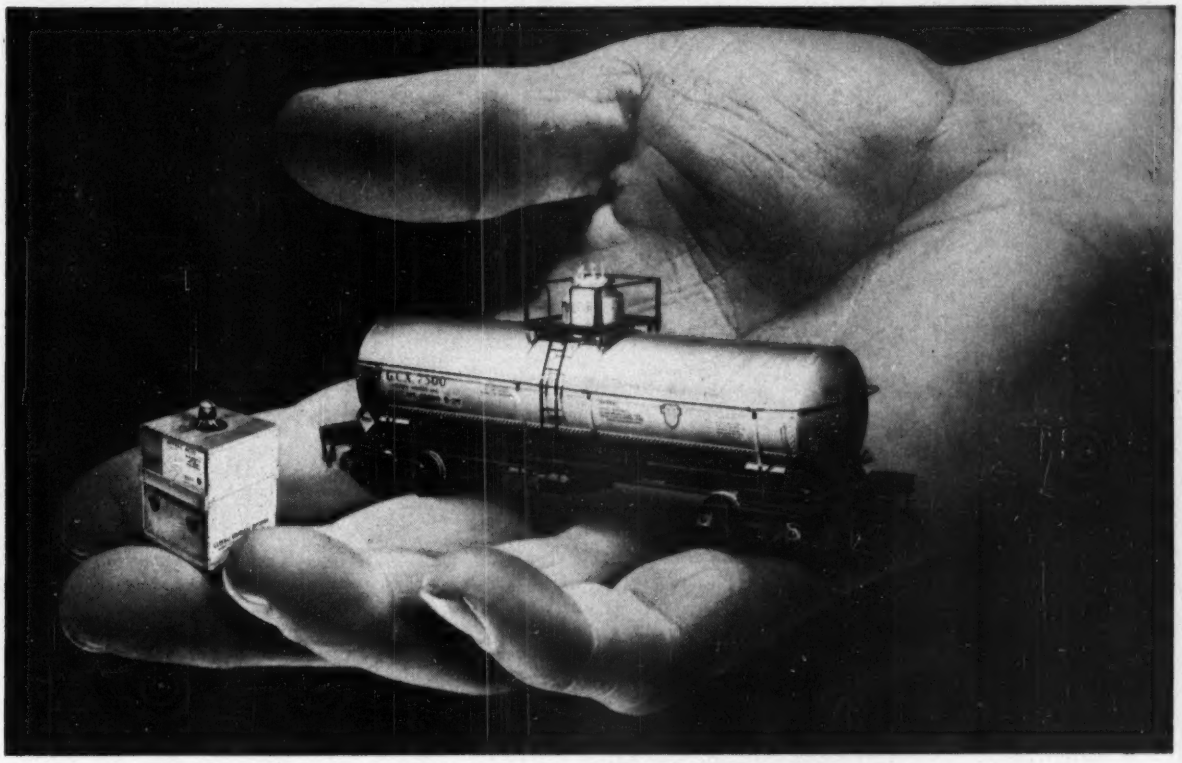
These sodium-coated solids remain free-flowing over a wide temperature range even in mixtures containing as much as 30 percent sodium. Their tremendous surface area makes the sodium highly reactive.

Advantages of high surface sodium are: (1) easy control of reaction rates and temperatures above and below the melting point of sodium; (2) adaptation to continuous operations; (3) dry reactions of sodium; (4) elimination of flammable solvents; (5) high yields; (6) production of finely divided and reactive products; and (7) avoidance of induction periods.

High surface sodium can be used to reduce metal

(*Continued on page 112*)

use acids?



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salts and oxides to finely divided metals such as zinc, iron, lead, copper, nickel, platinum, titanium and zirconium. With it, sodium hydride and sodamide can be produced where needed for subsequent reactions. In the purification of gases, hydrocarbons and ethers, high surface sodium removes oxygen, nitrogen, halogen and sulfur compounds, moisture and certain other trace impurities. It can be used to make organic sodium derivatives. And it can be used as a catalyst for rearrangement reactions, hydrocarbon cracking and polymerizations.

High surface sodium is made by mixing molten sodium with any inert solid. Usually, sodium spreads over the surface of hot dry solids between 100 and 200 deg. C. The mixing can be done, for example, in an agitated steel reactor blanketed with nitrogen. The sodium-coated solids can be used in the same vessel in which they are made. U. S. Industrial Chemicals Co., which markets sodium manufactured by National Distillers Chemical, shows users how to make high surface sodium in their own plants.

Among inert solids that can be used as carriers are salt, sodium carbonate, carbon, powdered metals, aluminum oxide and silicon carbide. Often the products from sodium reactions can function as carriers.

Salt can carry from 2 to 10 percent sodium; soda ash, 10 percent; alumina, 20 to 25 percent; and activated or colloidal carbons, over 30 percent sodium. Within these concentrations, the coated solid flows freely. This free flow can be maintained up to the boiling point of sodium (883 deg. C.), depending on the temperatures that the carrier can withstand. Thus high surface sodium can be handled in fluidized and other moving solids systems.

High surface sodium reduces chlorides and oxides of metals to colloidal metals at relatively low temperatures (125 to 250 deg. C.) with rapid reaction rates and high yields. Often the reaction product itself can be used as the sodium carrier by recycling part of the reaction mixture to make more of the high surface sodium.

Nickel and platinum catalysts for hydrogenation can be made by reducing nickel oleate or chloroplatinic acid with the new form of sodium.

In hydrocarbon refining, high surface sodium can be used in fixed or moving solids systems for thorough refining at operating temperatures above and below the melting point of sodium (97.5 deg. C.). Sulfur in certain petroleum naphthas has been reduced to less than 0.001 percent.

Vapor phase refining of hydrocarbon fractions with boiling points up to 275 deg. C. can be carried out with agitation in an inert atmosphere using sodium on soda ash.

In liquid phase refining, high surface sodium is added to the petroleum fraction with agitation at the temperature necessary to get the required refining. Solids can be filtered out. But since certain sodium derivatives among the reaction products are soluble in hydrocarbons, distillation is often required to get a neutral product.

The new form of sodium effectively removes water, alcohols, acids, aldehydes, ketones and peroxides from ether. Diethyl ether, 1,2-diethoxyethane and tetrahydrofuran have thus been purified in the vapor phase with sodium on soda ash.

Sodium hydride, with particle size below 10 microns, can be made from high surface sodium and hydrogen. Salt, soda ash and alumina can be used as carriers. Adding colloidal carbon gives the maximum rates of hydrogen absorption by sodium on salt. Mixtures of sodium hydride and salt can be made by continuous or semi-continuous charging of sodium, hydrogen and small amounts of colloidal carbon. On a weight basis, a 35 percent sodium hydride mixture is equivalent as a condensing agent to an equal weight of pure sodium ethylate.

Sodium hydride made by the new method furnishes an alkaline non-reducing agent for Claisen condensations. Thus it can be used to condense methyl laurate with acetone.

Sodium dispersions in organic media (toluene, xylene, kerosene, octane, mineral spirits or naphthalene) also possess high surface area. The sodium in such a dispersion is present as droplets averaging 10 to 20 microns in diameter and in concentrations up to 50 percent by weight.

Sodium dispersions can be used in metallation reactions, Claisen condensations, Wurtz reactions, reductions, catalytic polymerizations and the production of alcohol-free alkoxides.

Many compounds can be made from sodium dispersions. Among them: phenylsodium, amylsodium, fluorenylsodium, sodium anilide, acetoacetic esters and sodio-malonic esters.

Continuous melting and vacuum casting

Continuous, vacuum melting furnaces, developed by National Research Corp. of Cambridge, Mass., now make it possible to charge raw material and remove vacuum-cast ingots from furnaces without cooling the crucible or breaking the vacuum in the melting chamber.

Vacuum melting furnaces are used in the production of titanium, zirconium, molybdenum and other specialty metals and alloys.

Vacuum Metals Corp., wholly-owned subsidiary of National Research, uses such vacuum melting furnaces for the commercial production of gas-free high-purity metals and special alloys. National Research also manufactures large furnaces for continuous vacuum melting.

(*What's Happening, turn to page* 114)



GOING PLACES *in plastics*

Latest wrinkle in sports cars is a plastic body that *won't* wrinkle. And while it may be some time before this development catches up with the family car, nevertheless it demonstrates the ingenuity of the manufacturers and fabricators of plastics.

Paralleling the rise in the use of plastics is the consumption of chemicals needed for their manufacture. Among plastics and resins producers, Mathieson is widely recognized as a dependable source of such essential raw materials as: caustic soda, liquid chlorine, ammonia, ethylene oxide, ethylene glycol, diethylene and triethylene glycols and ethylene dichloride.

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caustic soda • soda ash • liquid chlorine • sulphur • sulphuric acid • bicarbonate of soda • ammonia • sodium nitrate • nitric acid • hydrazine sodium methylate • sodium chlorite • hypochlorite products • dry ice and carbonic gas • ammonium sulphate • ethylene derivatives • methanol

What's Happening

Phillips Steps Up Output Of Nitric at Texas Plant

Nitric acid capacity at the Cactus plant, Etter, Tex., will be increased by 110 tons per day when facilities now being constructed are completed. The government-owned nitric acid plant is operated under lease by Phillips Chemical Co., which will own and operate the new facilities. The added nitric capacity should be ready for operation late this year.

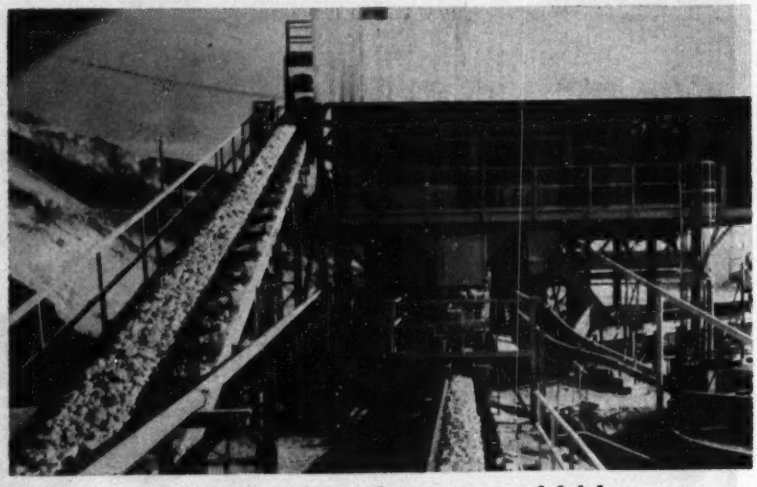
Chemical & Industrial Corp. of Cincinnati is handling the process and design for Phillips under contract. Construction will be done by Chemical Processes, Inc.

The government-owned plant at Etter, formerly the Cactus Ordnance Works, was leased in 1948 by Phillips Chemical. When Phillips took over, ammonia was the only fertilizer material being produced. Since then Phillips has doubled ammonia capacity and installed nitric acid production facilities. Phillips continues to operate both the ammonia and nitric acid plants under lease from the government. Later the company installed an adjacent plant, which it owns and operates, to produce ammonium nitrate and nitrogen solutions. The increased production of nitric acid will make possible greater output of fertilizer in solid form.

New Triple Super Plant For Royster in Florida

A $3 million triple superphosphate plant will be built near Mulberry, Fla., by F. S. Royster Guano Co. When completed early next year, the plant will be able to turn out about 70,000 tons per year of triple super.

The product will be made from pebble phosphate mined on company holdings in Polk County, Fla. Royster has 20 plants in 11 states.



FEED goes in on belt conveyor at left, product comes out on belt below.

HMS Upgrades Dolomite

Kaiser's new sink-float unit reduces silica content of crushed rock before calcination. Result—reduced waste ratio and better kiln operation.

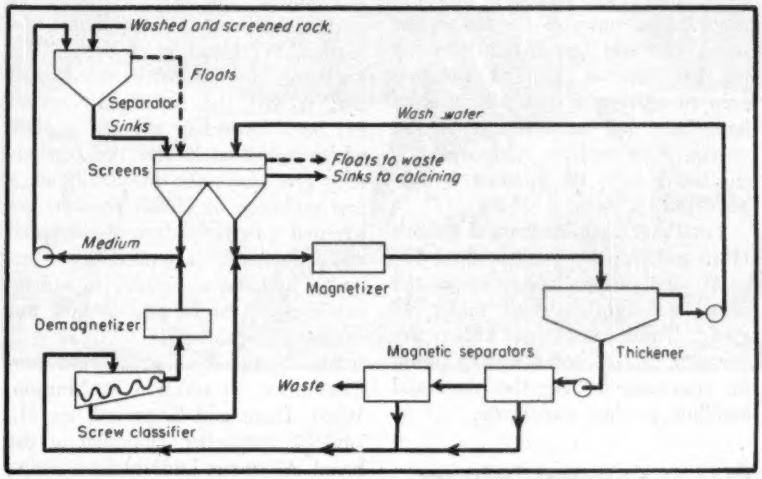
Facing decreasing supplies of top-grade mineral raw materials for chemical processes, chemical engineers are more and more turning to the application of mineral engineering techniques for upgrading these materials. A comprehensive symposium on such techniques occupied a prominent place on the program at the recent AIChE meeting at Biloxi, Miss.

A good example of how such techniques can be used in chemical operations is the heavy media separation unit at Kaiser Aluminum & Chemical Corp.'s dolomite plant at Natividad, Calif. This unit, which can handle 200 tons per hr. of dolomite, went on stream in March 1952. Kaiser says its operation during the past year has been "more than satisfactory."

Primary function of this unit is to reduce the silica content of the rock before calcination. Silica content of the feed averages 2.7 percent SiO_2, sometimes running as high as 7.7 percent. The unit separates out a high-silica fraction (about 23 percent SiO_2), so that the product contains, on the average, only 0.6 percent SiO_2. The operation is economically justified by a reduced waste ratio and better kiln operation.

▶ **Sink or Swim**—Heavy media separation (HMS) consists of passing a mixture of minerals through a liquid medium of definite and controlled density. The lighter materials float in the medium; heavier materials sink to the bottom. With most minerals, including iron ore and dolomite, the desired product is heavier. In coal

in Chemical Engineering



SLURRY of magnetite and ferrosilicon in water forms the heavy medium.

processing, where HMS is used extensively, the coal floats and the impurities sink.

First commercial HMS plant was put into operation by American Zinc, Lead and Smelting Co. at Mascot, Tenn., in 1937. American Cyanamid later pooled its patents on the process with American Zinc's and has been licensing the process to industry for some ten or twelve years.

Heavy media separation took hold quickly in the metallic minerals field, where there were large marginal ore reserves and dumps containing mineral values uneconomical to recover by any other method. Several HMS plants were in operation on waste dumps by 1943, and since then plants have been installed throughout the world to recover or upgrade coal, iron ore, magnesite, dolomite, tin, lead, zinc and other minerals.

▶**HMS Operation**—The principal units of any heavy media plant are: A separatory vessel; a pump to circulate the medium; screens to wash the medium from the minerals; medium recovery and cleaning devices (usually thickeners and magnetic separators); a densifier to dewater the cleansed medium.

The early HMS separatory vessel was a cone with an air lift raising the heavies from the bottom. The cone is still one of the most common separatory vessels used, but designers have turned to a number of other types of equipment, including spirals and drums with lifters to separate the sinks and the floats.

Galena was the first medium used; standard froth flotation methods recovered it for re-use. Present-day operations, however, rely upon a magnetic medium such as magnetite or ferrosilicon. Using a wet magnetic separator, it is a simple operation to recover the medium and discard the contaminating fine rock particles.

▶**Kaiser's Problem**—The Natividad quarry, unlike most eastern dolomite quarries, is interlaced with granite dikes and intrusions of various sizes going in all directions. Before installation of the heavy media plant the decomposed granite, being softer than the dolomite, was removed by dry screening after primary crushing. By using care in selection of rock from the quarry Kaiser could recover a good grade of rock, but at the expense of a rather high waste ratio.

As the quarry was extended the granite increased in hardness and quantity, became less amenable to beneficiation by screening. In 1950 Kaiser decided that a heavy media plant would probably improve the quality of the various end-products, increase the yield per ton, reduce the total quarry waste ratio and minimize the importance of selectivity at the quarry face. Pilot runs were carried out in the spring of 1951; the commercial unit started up last year.

▶**Kaiser's Solution**—Washing and screening of the rock before introducing it to the HMS plant is essential in order to have the feed properly sized and free from fines. At Kaiser this is done in a Hardinge scrubber and washing screen.

From the scrubber, the ¼ to 4½-in. rock is moved by belt conveyor to the chute feeding the 18-ft. diameter by 15-ft. high HMS cone. The medium recirculation pump also discharges into this chute.

As soon as the rock enters the cone the separation starts, with the heavies sinking to the bottom and the floats emerging on the top. An agitator in the cone sets up a clockwise rotation of the whole mass, and the floats are

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carried around about 270 deg. to the outlet chute and screens. At the same time the heavies sink to the bottom, where they are picked up by the center column air lift and discharged along with a large flow of medium into a chute leading to the wash screen. Air consumption is about 260 cfm. at 60 psi.

The 11¾-in. diameter central column in the cone not only serves as the air lift but also acts as the drive shaft and support for the agitating rakes.

The wash screens consist of two sets of two Allis-Chalmers low-head 5 × 12-ft. double-decked screens in series. Each of these screens is divided to give about one-third of its area for floats and two-thirds for sinks. The top deck is dressed with ¾-in. round-hole punched plate and the bottom deck with ¼ or ⅛-in. square mesh cloth, depending upon operating conditions. About 6 ft. of the first screen is used to drain the medium directly into a sump for immediate recirculation. Further washing by spray nozzles on both decks removes the balance of the medium.

The medium recirculation pump is an 8-in. Wemco sand pump, driven by a 125-hp. motor. About 1,000 gpm. is circulated, most of which goes to pre-wet the incoming feed and wash it into the cone. Some of it, however, can be diverted through pipes extending for various depths into the cone to adjust the density of the main body of the suspension.

▶**Medium Recovery**—All of the ferrosilicon-magnetite medium washed from the rock drains into a 20-ft. thickener. Before entering the thickener it is magnetized by a permanent magnet to promote flocculation and settling of the fine magnetic particles. The thickener underflow is pumped to a 48-in. Dings magnetic separator, where the magnetic material is separated from the non-magnetic rock and slime. The non-magnetic portion passes through a 36-in. secondary or scavenger magnetic separator before finally going to waste. Overflow from the thickener goes to a pump which recirculates water to the washing sprays.

Magnetic material from both separators runs into a 48-in. Wemco spiral classifier, which serves as a dewatering device for the medium and returns the solids to the medium sump at a specific gravity of about 3.40. The specific gravity of the medium within the cone is held within 0.1 point between 2.65 and 2.75, depending on composition of the rock being processed.

There are two control points for regulating the specific gravity of the medium entering the cone—the amount of magnetic material returned to the medium sump from the screw classifier, and the amount of water directed from the sink wash to either the medium sump or the wash-water sump. Medium loss is less than 0.4 lb. per ton of finished product, even though more than 100 tons of ferrosilicon and magnetite are in the system. The medium composition is checked hourly; the product is analyzed once a day.

Total water requirements of Kaiser's HMS and scrubber plant is about 800 gpm., but recirculation keeps the actual consumption well under 50 gpm. Total connected horsepower amounts to 324, not including power for conveyors feeding the plant and handling product and waste.

Role of Chemical Industry Theme for RPI Session

The vital role of America's chemical industry in world economy and the defense of free nations will be explored by social studies teachers from all parts of the nation at the second Industrial Council at Rensselaer Polytechnic Institute, May 15 and 16. The first council, held last spring at Rensselaer, was concerned with the story of petroleum.

The chemical industry will be host to more than 850 high school and college faculty members at the May meeting. National authorities will address the session on the widening influence of the chemical industry. Educators will participate in nine panel discussions dealing with activities of the chemical industry.

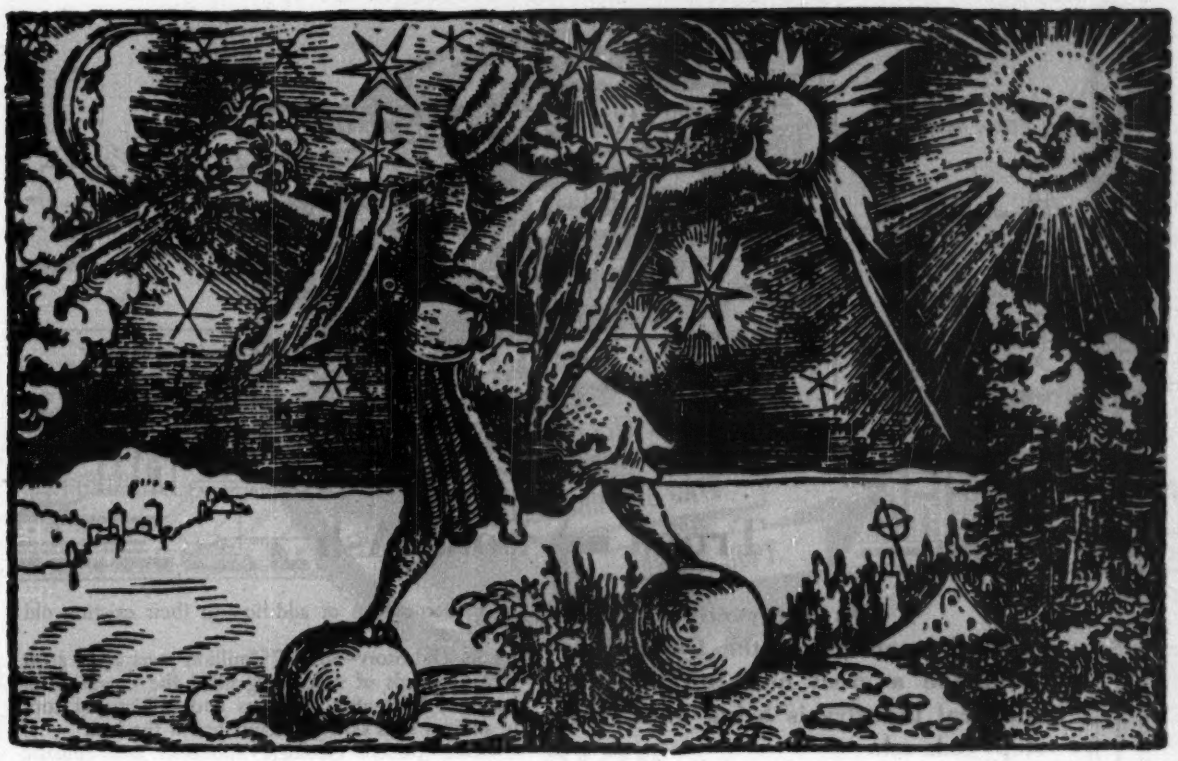
Dr. Ray Palmer Baker, vice president of Rensselaer and director of the Industrial Council, says that about 100 authors, editors and public opinion specialists will attend. Nearly 200 executives and scientists from the chemical industry will be present.

Attending as members of the Council's Advisory Committee will be: Charles S. Munson, chairman of the board, Air Reduction Co., president of the Manufacturing Chemists' Association, and William H. Ward, vice president of E. I. du Pont de Nemours & Co., chairman of the board, Manufacturing Chemists' Association, both *ex officio*; Leland I. Doan, president of Dow Chemical Co., and General Brehon Somervell, president of Koppers Co.

"Teachers in the social studies have been invited to take part in the council because of their responsibilities in interpreting the social structure for youth," points out President Livingston W. Houston of RPI. "We are living in an industrial society and that is why the Industrial Council has been formed as a meeting place where industrial leaders and teachers may give and take informally in a free exchange of ideas. Teachers are afforded a better picture of the social and economic responsibilities accepted by today's corporations and are better equipped to explain how our society is organized."

Members of the Council's Advisory Committee, in addition to Munson, Ward, Doan and Somervell, are Hiland G. Batcheller, chairman of the board, Allegheny Ludlum Steel Corp.; Arthur H. Bunker, president, Climax Molybdenum Co.; S. Sloan Colt, president, Bankers Trust Co.; James J. Cosgrove, board chairman, Continental Oil Co.; Allen B. Du Mont, president, Allen B. Du Mont Laboratories; John G. Forrest, financial editor, *New York Times*; G. Keith Funston, president, New York Stock Exchange; George V. Holton, board chairman, Socony-Vacuum Oil Co.; Barry T. Leithead, president, Cluett Peabody & Co.; Philip D. Reed, board chairman, General Electric Co.; and Lewis A. Wilson, commissioner of education, New York State.

Members of the program committee for the chemical industry session of the council are: M. L. Crossley, research consultant, American Cyanamid Co.; W. E. Hanford, director of petroleum and chemical research, M. W. Kellogg Co.; Sidney D. Kirkpatrick, vice president and director of editorial development, McGraw-Hill Book Co.; Walter J. Murphy, editor, *Chemical & Engineering News*; M. L. Tainter, vice president, Sterling Drug, Inc., director of Sterling-Winthrop Research Institute, and Robert L. Taylor, vice president, Hill & Knowlton, Inc.



Unlimited Capabilities

The Magi of old were held in great esteem because they were thought to have unlimited powers over all the forces of nature. They were the "good" magicians. Their opposites, sorcerers who practiced black magic, were believed to have power only over the forces of evil.

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Allyl Chloride has many other interesting possibilities for new products . . . possibilities that await only your exploration.

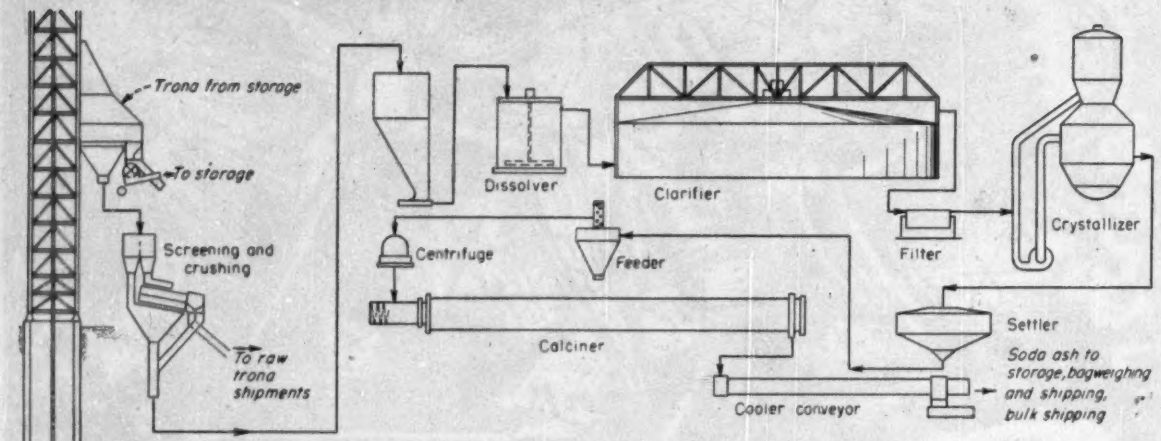
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Trona ➡ Soda Ash

On the recently-discovered mineral resources of the Green River formation a great new Intermountain chemical industry is being built. First step: soda ash.

Practically all the bugs which infest a new process have been exterminated and the new soda ash plant of Food Machinery & Chemical Corp. is now in operation.

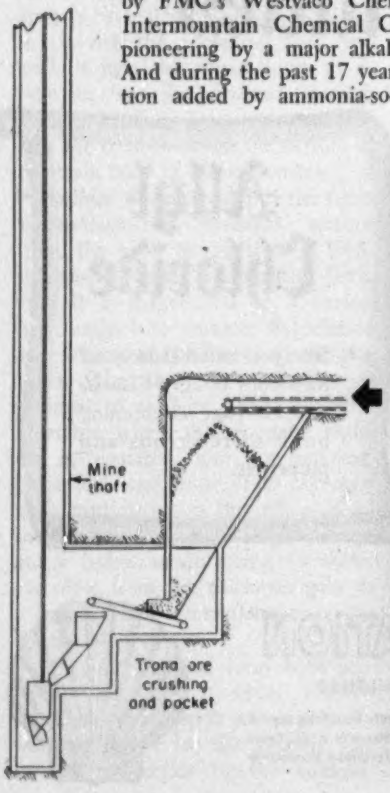
The plant at Westvaco, Wyo., will be operated by FMC's Westvaco Chemical Division for the Intermountain Chemical Co. It is the first real pioneering by a major alkali producer in 41 years. And during the past 17 years the only new production added by ammonia-soda producers has been by modernization or addition to their existing old facilities.

►**Old, Old Story**–Some 75 million years ago a great lake hundreds of miles long filled the Green River basin of Wyoming. Millions and millions of tons of sodium salts slowly precipitated in the bed.

Aeons passed. Geologic upheavals and climatic changes took place. Nature carried on a tremendous chemical processing operation far underground.

Tentative probing of an oil test drill 14 years ago revealed the chemical treasurehouse. It was confirmed as a bed of practically pure trona 10-20 ft. thick at an average depth of about 1,500 ft.

Trona is a relatively rare, non-metallic mineral, $Na_2CO_3.NaHCO_3.2H_2O$. Pure material contains 70.39 percent sodium carbonate and by calcination the excess CO_2 and water can be driven off, yielding natural soda ash. (Continued on p. 120)







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Test holes and marketable soda ash are years and dollars apart. The first working shaft, 12 ft. in diameter, was sunk by Westvaco in 1947. Tunnels fingered into the trona bed. Countless man hours and $2 million were invested in mine development and pilot plant before it was decided to proceed with the present facilities.

Today, in 1953, the $18-million, 300,000-ton plant is ready.

▶ **Significance**—Current consumption of soda ash is about 5 million tons per year. Consumption has been and is growing at a rate of about 170,000 tons per year.

If you were to build a new ammonia-soda plant it would cost you about $30,000 per daily ton. And you would be in competition with plants that have been depreciated to as low as $3,000 per ton.

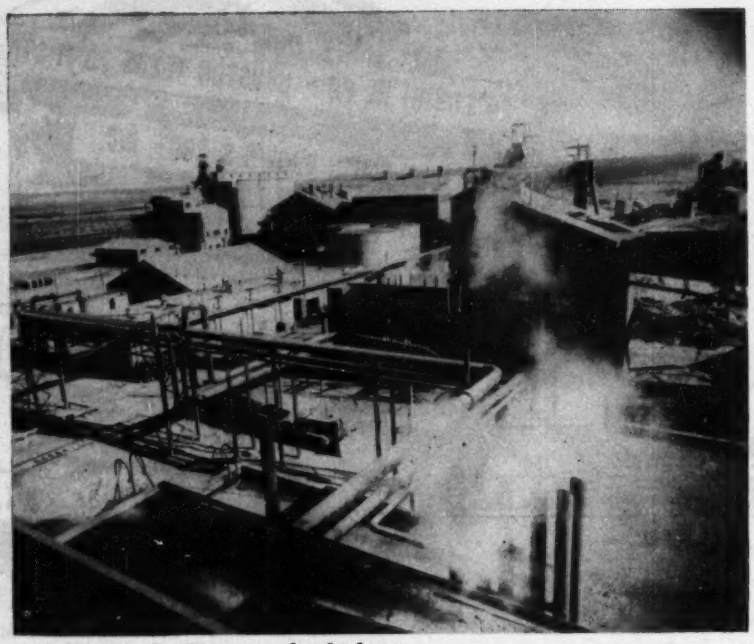
The new Westvaco plant, therefore, provides a bulwark for all soda ash consumers against any foreseeable national ash shortage. It is both a stabilizing influence and a major development of a great natural resource of ultimate benefit to all users of soda ash everywhere in the United States.

▶ **The Process**—Mining, processing and purification operations are comparatively simple. Crude trona is mined, crushed and dissolved, and the insoluble shale is filtered out. The solution is decolorized and the refined ash is crystallized.

Although the process is simple and relatively inexpensive, mine development and surface plant took lots of time, work and money.

As the first 300,000-ton unit comes on stream, more than 7 mi. of tunnels have been drilled. A new 10-mi. pipeline brings 600,000 gal. of water every day from the Green River. A 20-mi. pipeline delivers natural gas to the power plant that provides steam and electricity.

▶ **Intravenous Activity**—Within the vein of trona, mining activities are similar in many respects to those of coal mining. Undercutting, drilling, blasting, loading onto shuttles, dumping onto conveyors. The main conveyor—to eventually be a mile long—dumps the ore into an underground crusher. From the crusher, ore drops into a storage hopper. Skip hoists feed on the hopper in 7-ton bites. They disgorge their meals ½ mile above and are insatiably back for more in two minutes.



ON STREAM—the Westvaco soda ash plant.

▶ **Surface Activities**—Above ground a huge stockpile smoothes the flow of ore from mine to plant.

Actual processing begins with solution. Crushed and screened trona is elevated to a hopper which feeds the dissolvers where mother liquor from the settler and a little make-up water take the trona into solution. Temperature is 200 deg. F., the boiling point at this 6,200-ft. elevation. There are two lines of three dissolvers and each line feeds an 80-ft. Dorr clarifier. The two clarifiers feed one thickner. Waste from these contains the 5 percent shale which is in the trona.

Overflow of the clarifier passes through a surge tank, and is filtered to take out organic and other impurities that would cause foaming in the crystallizers.

The stream of feed liquor is again split into two lines. Each goes to a trio of Struthers-Wells evaporators. The product stream (now 20-30 percent solids) passes through a settler and centrifuge to the 90-ft. calciner. Here (where the only chemical change of the whole series of operations takes place) the $Na_2CO_3.NaHCO_3.2H_2O$ becomes natural soda ash.

Most of the ash from the calcining kiln is cooled and conveyed to storage, bulk shipments, or bag filling, weighing and shipping. Part of it is hydrated to dense ash. As much as half of the plant's 300,000 tons per year capacity can be processed to dense ash—used primarily for glass manufacture.

▶ **Problems and Materials**—Winters in Wyoming are severe. And efficiency demands saturated solutions and high solution temperatures. A drop of 2 deg. in the solution pipelines would solidify the ash into a solid plug. So all lines are steam traced and designed to operate even though outside temperatures get down to —40 deg. F. in winter.

Other than those imposed by size, there are no particular materials handling problems. All the trona and finished ash is handled with conveyors, bucket elevators and hoppers. Carbon steel is the material of construction for piping and other liquid-handling equipment except pumps which are stainless steel.

▶ **Customers**—Although western industry and population have grown tremendously, only 6 percent of soda ash production is now west of the Mississippi and north of the Gulf Coast area. Yet, within an economic shipping distance from Westvaco, Wyo., 30 percent of all U. S. soda ash is now consumed.

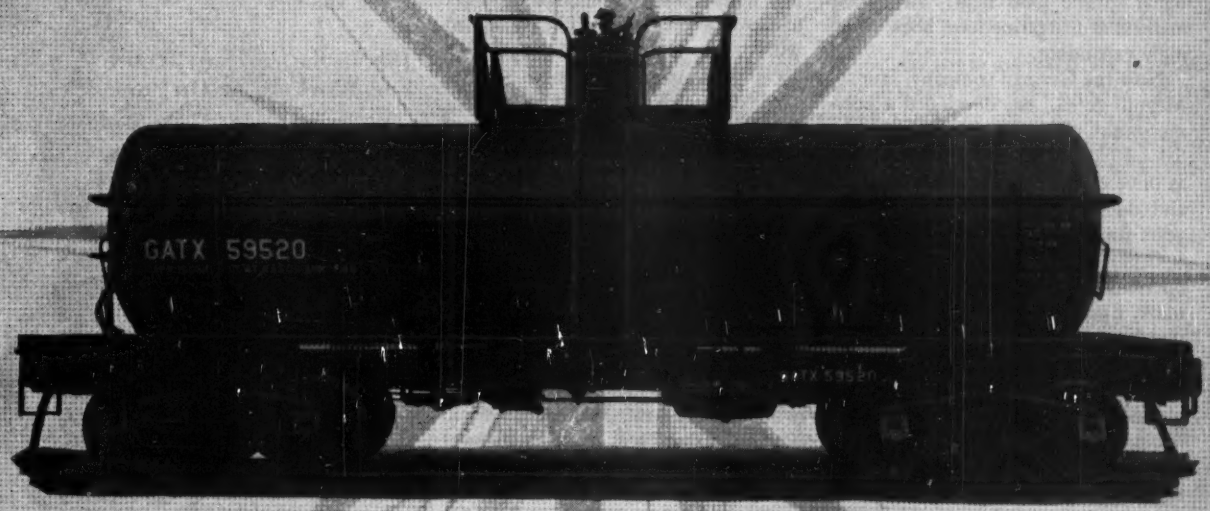
Westvaco will serve not only our growing West, but all of us whose fortunes depend on an assured and expanding supply of soda ash in the future.

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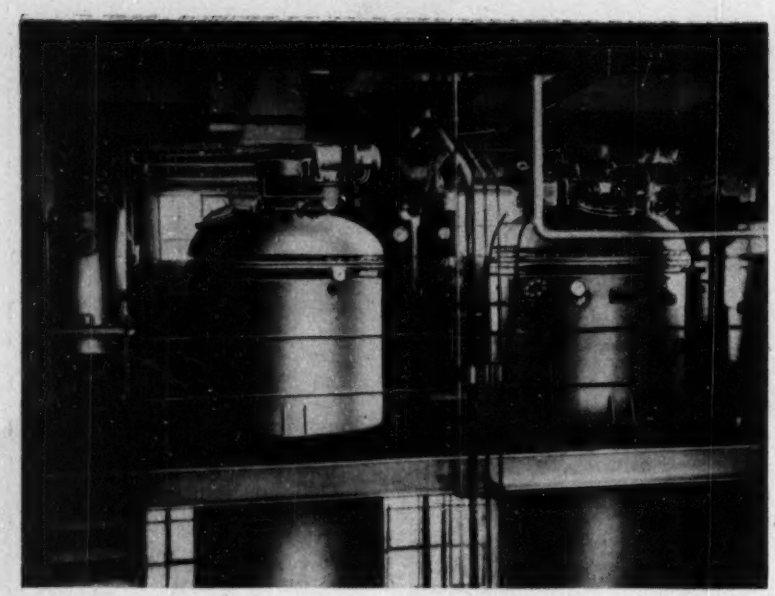
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REACTOR for polymerization via expansion of fine water particles in "special" steam.

"Wet Steam" Upgrades Fish Oil

Just enough detail has been released on a process for producing edible, odorless fish oils to outline what seems to be a unique engineering development.

U. S. producers of fats and oils, bedeviled by dwindling of such markets as soap, may find themselves with a little more to worry about in the form of new competition. Where possible, many of them have been shifting their sights to the food field. And such markets as margarine have been obligingly expanding.

Now the German company, Bamag-Meguin A. G., has developed a polymerization process that is said to make fish oil (1) edible—about as digestible as olive oil; (2) permanently tasteless and odorless; (3) stable after three years storage.

Commercial plants are already in operation in Norway, Iceland, Denmark, England and Germany. Typical plant capacity is 20 to 50 tons a day of roe oil. Product is being used as a low-priced constituent of such food products as margarine, mayonnaise and fish-preserve oil. Polymerized fish oil can make up as much as 40 percent of the content of margarine, the only limiting factor being hardenability. The Norwegian sardine-canning industry reportedly uses it instead of olive oil and pays 75 percent less for it.

Through its New York representative, General Industrial Development Corp., Bamag is now introducing the process to this continent. Company officials have their eyes on areas like our Pacific Northwest, where the fishing industry is big enough to offer cheap raw material. This, coupled with their process's low operating costs, high yields and high product quality, should, they feel, make a place for polymerized fish oil in our food industry.

► **Vacuum and Wet Steam**—While unwilling to release many details either on the nature of the polymerization reaction itself or on how it is brought about, GIDC does state that the process hinges on the use of a "special" type of steam. Produced in a generator designed by Bamag, it is called "Wecker" steam after the man who developed it. The company will say only that it is a saturated wet steam with the water in the form of a fine fog-like dispersion.

The actual polymerization takes place at 200-250 deg. C. and high vacuum. A high-pressure steam generator takes care of indirect heating.

When the Wecker steam hits the heated feed stock and the vacuum in the reactor, the fine water particles in it expand, explosion-like, and form superheated steam. The expanding water particles actually play a part in the reaction. The resulting polymerization involves only a rearrangement of molecules and no structural changes like those which would result from condensation reactions. Iodine number declines from 128.3 to 95.4.

Amount of decomposition of the oil during the polymerization is negligible. This is in marked contrast to older polymerization processes. For instance, when fish oil is heated to 270 deg. C. while carbon dioxide or nitrogen is passed through it, increase in free fatty acid content may range anywhere from 0.5 to 12 percent.

Before the Bamag polymerization, a certain amount of pretreatment of the oil is necessary. This includes neutralization, bleaching and stearine elimination. Depending on the quality of the crude oil, neutralization may mean simple lye-deacidification or, if the free fatty acid content is more than 5 percent, distillation may also be necessary.

Following washing and drying, the oil must be bleached, not only for the sake of color but to remove slime which would give the oil a burnt taste after polymerization.

To remove stearine the oil is cooled down to a certain temperature, depending upon the desired turbidity of the oil, and filtered.

Job Is Safer Than Home For Workers at Du Pont

Du Pont workers are apparently safer at work than they are off the job.

Investigating accidents during a recent month, Du Pont's safety and fire protection division found the rate of time-losing injuries per million man-hours of exposure for employees at home was 6.01, while the rate for the company's employees at work for the same month was only 0.44.

Principal causes of injuries off the job, the Du Pont survey showed, were motor vehicle accidents, 40 percent, and falls, 30 percent.

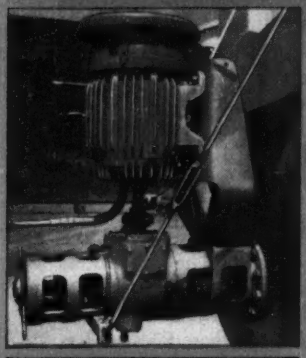
In 1952, Du Pont set a new safety record of 0.60 injuries per million man-hours. This compared with 5.48 for the chemical industry as a whole and 9.06 for all industry.



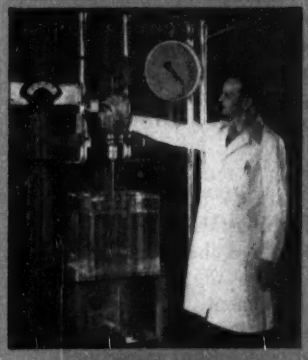
LIGHTNIN 200-HP MIXER, one of six units on battery of antibiotic fermenter tanks. These units are available for open tanks or closed pressure vessels, in sizes from 1 to 500 HP.



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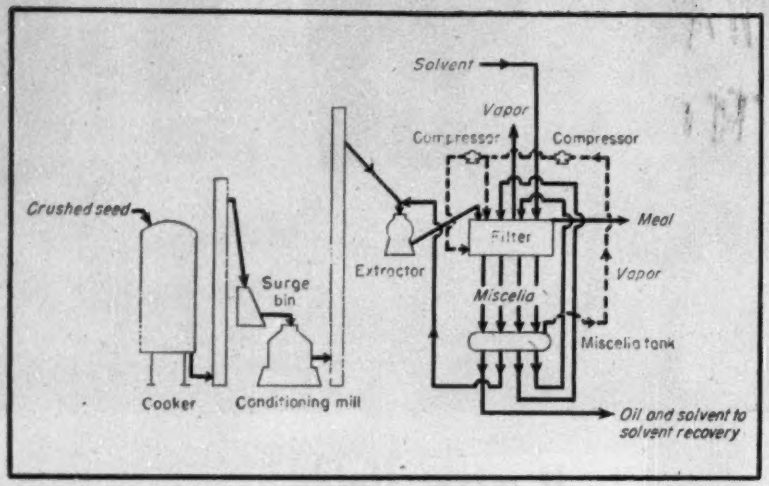
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Better Solvent Extraction

Interest is growing in new process for extracting oil from cottonseed. Based on the principle of pre-solution, the process may have many applications.

Although it was intended specifically for cottonseed application, the new filtration-extraction process may be lifted over a few fences before long. Southern Regional Research Laboratory, U. S. Department of Agriculture, completed promising pilot-plant experiments with the process last year.

Since then several engineering firms have applied to the Department of Agriculture, which holds the patents, for licenses on the process. So far, Vern E. Alden Co., Blaw-Knox, Wurster & Sanger, Day & Zimmerman and Lukenweld Div. of Lukens Steel Co. have been granted licenses. Other firms may soon join these.

Under the licenses, these companies will supply plants and equipment based on the pilot-plant data. Blaw-Knox, which calls the process Rotofil, and Lukenweld have already sold at least one plant each. Lukenweld's customer is Mississippi Cottonseed Products Co., Greenwood, Miss. Both new plants are expected to be ready this summer.

Lukenweld Div. is offering complete packaged plants to cottonseed-oil producers on a turnkey basis. Capacities will run 75, 100, 125 and 150 tons per day of seed.

The process may be applicable to other than cottonseed-oil extractions. Experiments are being conducted on soybeans, peanuts and rice brans. Reports are good, particularly for the soybean operations. Alden thinks the process may be advantageously applied to many chemical and food processes.

"Based on the principle of presolution followed by countercurrent washing, the process is applicable to the extraction of any soluble component from a solid phase," says Alden's R. E. Zinn.

▶ **Many Advantages**—According to SRRL, filtration-extraction will turn out oil in comparable yield and of comparable quality, with less solvent and power and lower operating costs than any other direct extraction process in operation today. Only one operator and a helper are needed per shift to run the plant; two operators, if rolling and cooking are done separately.

In addition, the installed cost of a plant is lower, which may make the process particularly attractive to smaller mills. A filtration-extraction plant requires fewer major pieces of equipment than for prepressing. A 150-ton plant takes up a space of only 20 by 45 by 40 ft.

Filtration-extraction has a number of advantages over direct extraction and over extraction with prepressing, SRRL says. In any solvent extraction process, preparation is the most important step. If preparation is poor, the removal of fines from the miscella is extremely difficult. The new process utilizes cooking to agglomerate fines, so that not only are there less fines in the miscella, but these fines are less difficult to handle in a polishing filter.

A versatile process, filtration-extraction can be used in any size plant. Prepressing plus extraction can be economically applied only to large capacities (200 to 400 tons per day).

In converting a screw-press or hydraulic-press mill to filtration-extraction, the filtration-extraction equipment would replace the presses and, in general, utilize the storage and preparation equipment.

How does filtration-extraction differ from conventional solvent extraction? Simply, this process substitutes a short mixing operation followed by filtration and washing for the usual diffusion and percolation operations.

In conventional processes, oil is extracted and countercurrently washed in the same vessel. In filtration-extraction, the same process is carried out in two separate vessels (*see cut*). Oil is put into solution in a slurry mixing tank. Then the concentrated miscella

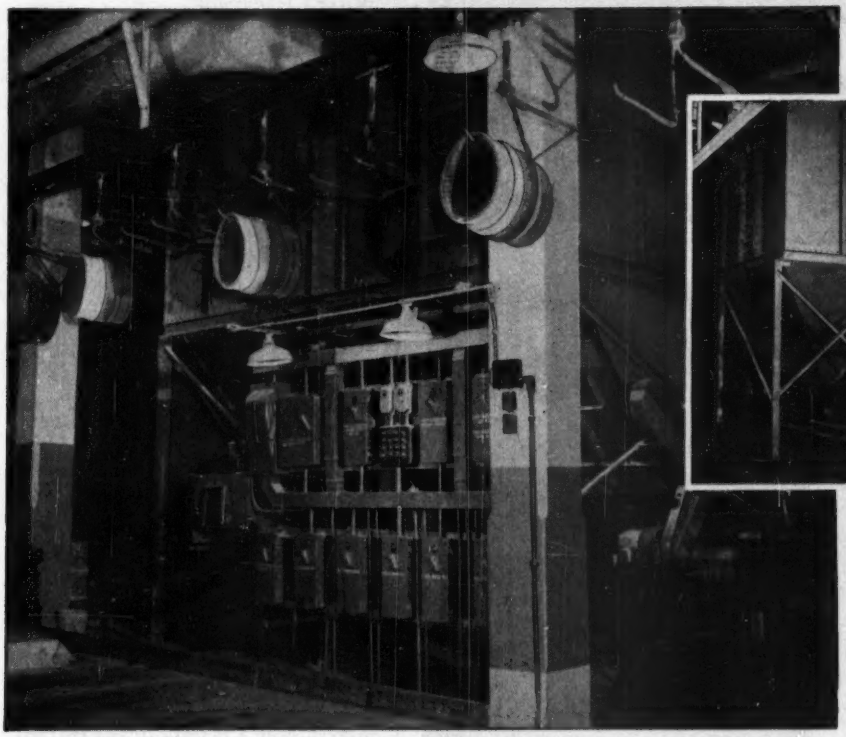
Oilseed Processes Compared

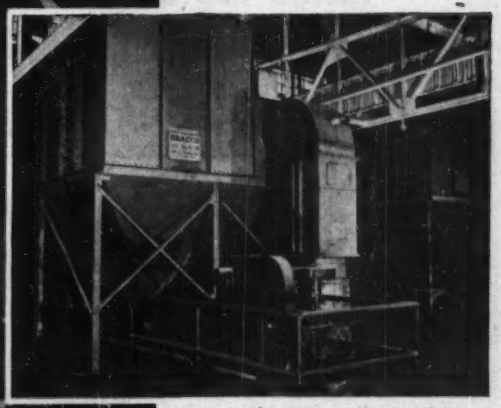
Hydraulic pressing—The oldest and still the most widely used way to squeeze oil out of cottonseed, requires a low capital investment, is cheap to maintain, and turns out oil and meal of a quality long accepted on the market. However, it requires a large amount of labor and leaves a relatively large amount of oil in the meal.

Screw pressing—Can be run continuously, requires less labor and recovers more oil than hydraulic pressing. But it has a higher initial cost, higher maintenance costs and higher power requirements.

Solvent extraction—Recovers more oil than either hydraulic pressing or continuous screw pressing; however, capital investment is higher than either. U. S. cottonseed processors first adopted the system five years ago when the price of cottonseed oil nearly doubled. It is used mostly in combination with pretreatment, usually by screw pressing.

Filtration-extraction—A recent development in solvent extraction, it eliminates the need for prepressing. For details see story.





(Above) Dracco Filters at Goodyear recover carbon black from Banbury Mixers.

(Left) Dusted tires on conveyor move past Dracco Filter which captures powder from dusting operations for re-use.

IT TOOK MORE THAN EQUIPMENT TO SOLVE GOODYEAR'S DUST PROBLEMS!

● Two special Dracco Dust Control systems were recently incorporated into existing processes at The Goodyear Tire and Rubber Co. in Akron, Ohio.

One system collects carbon black from Banbury Mixers; the other traps powder used for dusting uncured tires. In both systems Dracco's design provides for re-use of all collected materials by automatically returning them to process.

Even with superior Dracco Dust Control Equipment in these systems it took an extra something to assure highly efficient, integrated dust control. This was Dracco's *application engineering* which resulted in custom-designed installations exactly meeting Goodyear process requirements. This precise engineering was the key factor in turning Goodyear's dust problems into dust profits.

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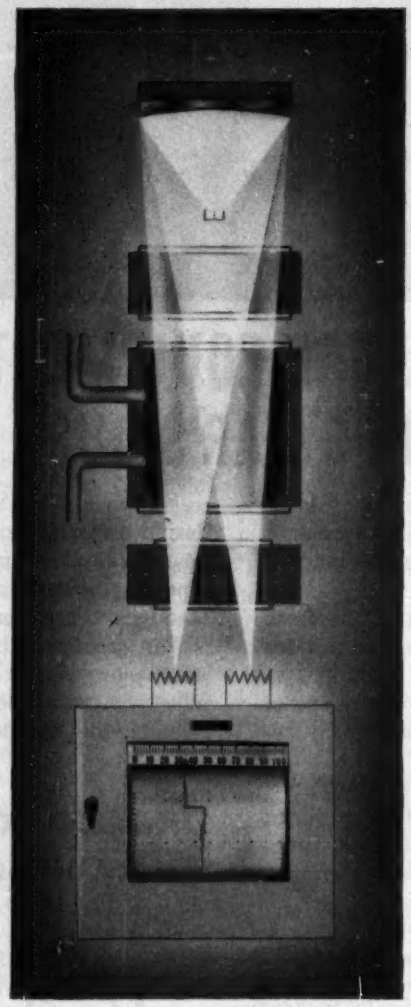
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PROCESS CONTROLS

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is separated from the meal in a standard filter. In this unit, weaker miscellas and, finally, commercially pure hexane wash the meal.

▶ **Cheaper In Long Run**—A 100-ton-a-day plant, according to SRRL, would cost $1 million—that excludes office buildings, control laboratory and steam-generating plant, but includes receiving and storage, mechanical preparation for cottonseed, flaking and cooking of the meats, filtration-extraction and meal processing. Of this total, $560,000 would go for equipment.

A hydraulic-press mill operator would have to lay out about $225,000 to convert his 100-ton mill to filtration-extraction; the direct or prepress mill operator, $25,000. If today's mills using mechanical pressing methods were converted to solvent extraction, the annual output of cottonseed oil in the U. S. would be boosted by 164 million lb., based on an annual crush of 6.0 million tons of seed.

With the new filtration-extraction process, only 1 percent or less residual oil is left in the meal. By comparison, the average hydraulic mill leaves about 4.5 to 6 percent of the oil in the residual cake; the average screw press leaves about 3.5 to 5.5 percent oil in the cake.

Thus a solvent plant can produce 40 more lb. of oil per ton of seed than a hydraulic plant, 20 lb. more than a screw-press plant. According to Lukenweld, at 15 c. per lb. market price, the gain in revenue (more oil) over a hydraulic plant with an annual crush of 20,000 tons would be about $90,000 a year; over a screw-press plant, $45,000 a year.

▶ **How It Works**—In the filtration-extraction process, rolled cottonseed meats go into a seed cooker. Cooking is carried out at a maximum temperature of 230 deg. F., which is lower than that used in preparation for hydraulic pressing.

After, cooking, the cooled material is mixed with miscella in a premixer. Practically all the oil goes into solution, forming a concentrated miscella. Solvent-extracting takes 15 to 25 min., compared with 45 to 60 min. for direct extraction and 30 to 50 min. for prepress extraction.

Slurrying is done at the relatively low temperatures of 80 to 90 deg. F. When higher yields are wanted the temperature may be raised to about 120 deg. F., the temperature level of

other solvent-extraction processes. The slurry contains about 40 to 45 percent solids by weight.

The concentration of oil in the miscella may be from 25 to 35 percent by weight, depending upon the solvent-to-meats ratio used. With conventional extractors, the maximum concentration of miscella attainable is around 20 percent. Because it operates at lower solvent-to-meats ratio, the filtration-extraction process obviously uses less solvent than conventional processes.

From the premixer the slurry is sent to a horizontal filter. Here strong miscella is separated from the meal by countercurrent displacement washing. Action is rapid, too rapid to depend on leaching.

First and second washes are made with weak miscellas; the third and final wash is with the hexane. Pressure drop across the cake is from 1 to 14 in. Hg.

The solvent-damp extracted meal, called marc, is finally discharged from the filter by means of a motor-driven scroll. Miscella is then evaporated and stripped for oil in the conventional manner. The marc is dried also by standard methods. It takes two hours to process the cottonseed, from the time the de-hulled seed is delivered until the finished meal is turned out.

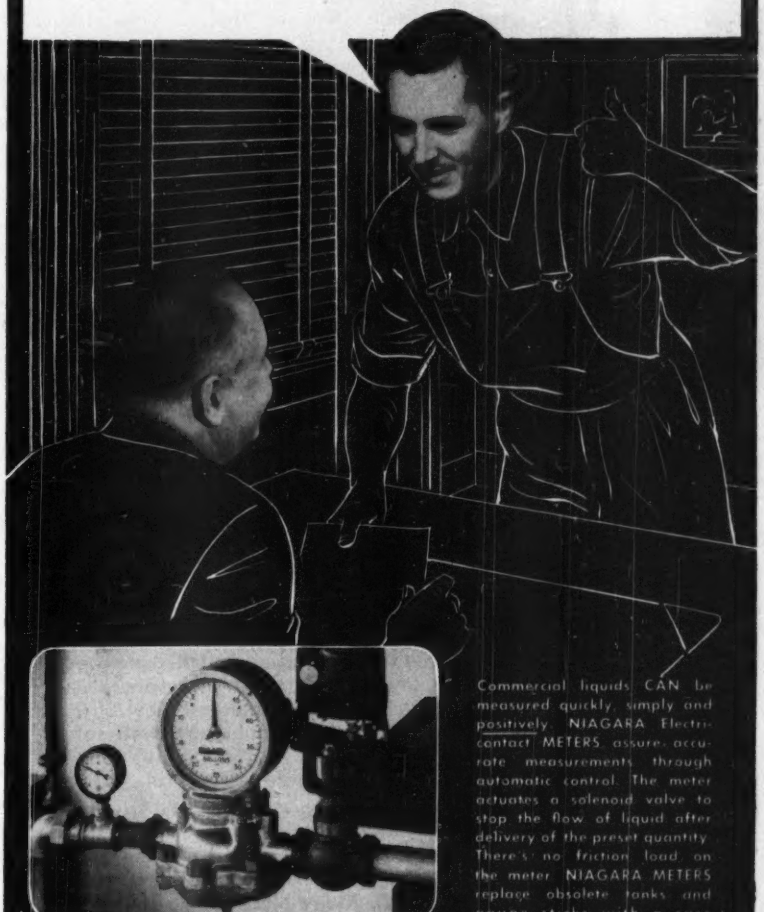
Heart of the process is the continuous, horizontal vacuum filter. It may be a standard commercial make—Lukenweld, for example, uses an Oliver. However, it requires a solvent-tight sheet-metal enclosure to prevent loss of solvent during operation.

According to a report by SRRL, using a 2-in. thick cake, the filtration can be carried out at a filter capacity rate equivalent to 3 to 4 tons of whole cottonseed per day per sq. ft. of filtering area.

▶ **Recent Trends**—While it is an advancement in extraction operation, filtration-extraction also will probably enhance the already growing prestige of solvent-extraction processes. Operators in the $470-million cottonseed business first began to use solvent extraction five years ago and really started to take to it two years ago. During the 1951-52 season, for instance, 15 to 25 percent of the crop was processed by solvent extraction, compared with 7 to 8 percent for previous year.

The trend to solvent extraction is shaping up. It is probable that sol-

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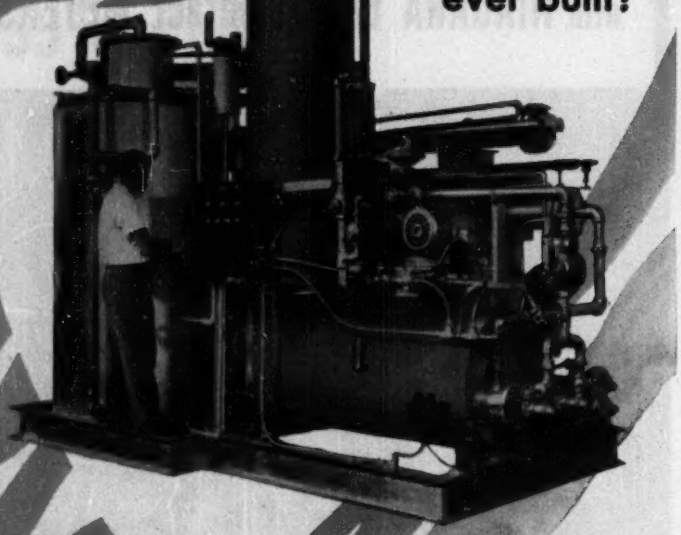
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vent extraction will account for 20 to 30 percent of the 1952-53 crop, screw pressing 25 to 35 percent and hydraulic pressing 50 to 55 percent. However, of the 21 solvent-extraction plants operating this season, only five are using direct extraction. The others are using screw presses for prepressing.

Operating for 300 days per year, present solvent-extraction plants can handle over 1.8 million tons. Right now, production for 1952-53 is estimated at about 6.0 million tons. Practically all the growth in solvent extraction has been made at the expense of hydraulic pressing.

AIChE Plans Big Session To Study Nuclear Processes

A week-long international meeting that will explore the chemical engineering aspects of nuclear processes is planned by the American Institute of Chemical Engineers for June 1954. Present plans schedule the meeting for June 20-25, 1954, at the University of Michigan, Ann Arbor, and experts from all over the world will be invited to participate.

In charge of the technical program is Prof. D. L. Katz, head of Michigan's Chemical Engineering Department, who was also recently appointed head of the Nuclear Energy Committee of the AIChE. The program, expected to be the most comprehensive ever on nuclear processes, will begin with a day-long conference on the educational problems in training engineers for the nuclear field.

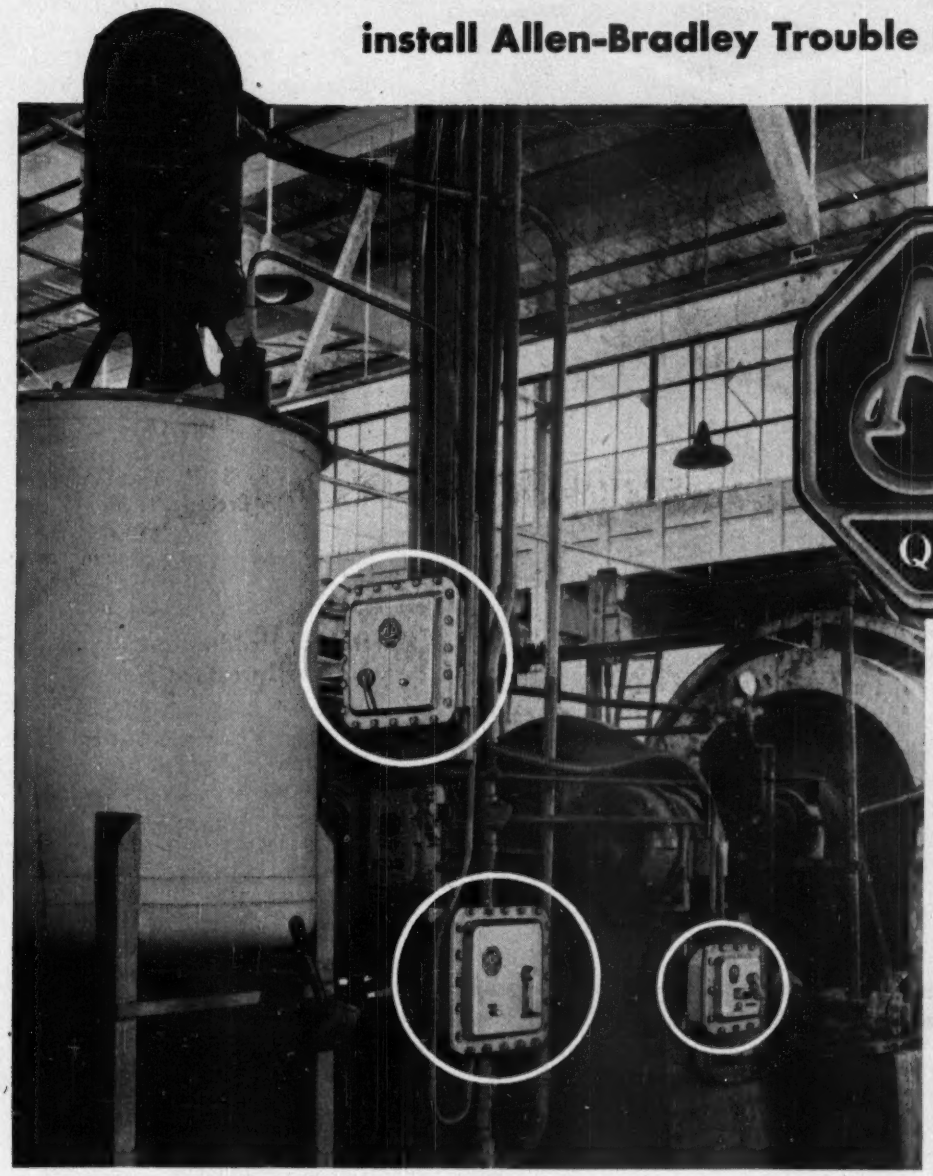
A two-day session is planned on the design of nuclear power reactors, and full technical discussion is scheduled in fuel resources, fuel preparation, chemical processing of spent fuel, disposal of radioactive products, use of isotopes, safety, instrumentation and control, and a conference on the social impact of the atomic age.

Host for the meeting will be the Detroit section of AIChE, and Dr. R. R. White, professor of chemical engineering at the University of Michigan, will be general chairman.

Members of the Institute's Nuclear Energy Committee who are planning the meeting are: D. L. Katz, chairman, University of Michigan, Ann Arbor, Mich.; R. H. Beaton, General Electric Co., Richland, Wash.; M. Benedict, Massachusetts Institute of Technology, Cambridge, Mass.; G. G.

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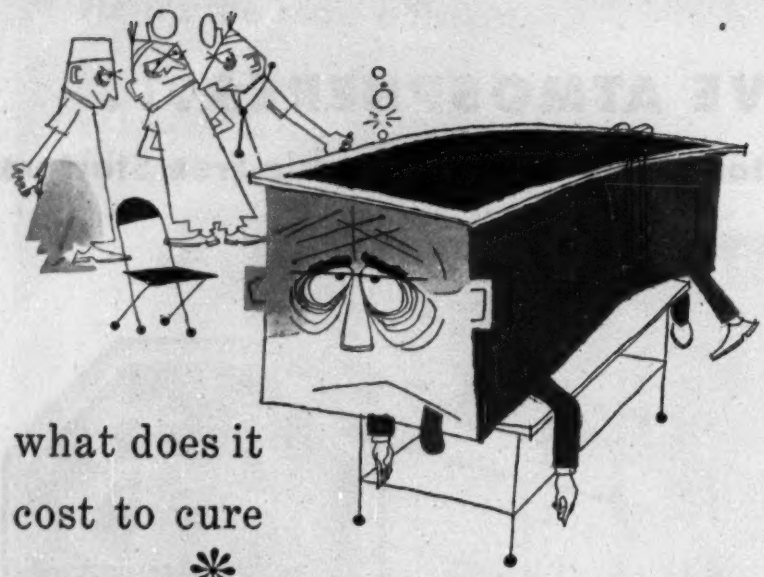
Where hazardous gases or vapors exist, install Allen-Bradley motor controls in NEMA Type 7 enclosures. Constructed of cast iron with wide machined flanges, these installations provide maximum protection to man, motor, and machine.

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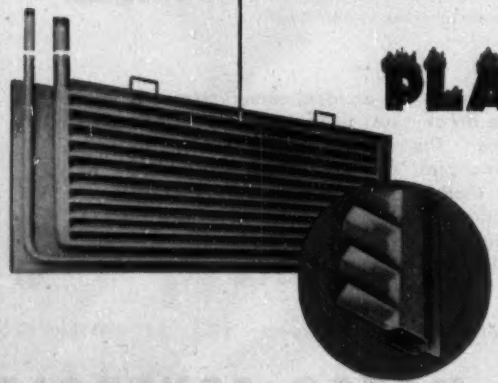
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Sulfur Production Planned In Northwestern Nevada

Central Eureka Corp. expects to acquire a sulfur production enterprise in northwest Nevada. Up to now, Edward H. Heller, a principal stockholder of Central Eureka, has financed and developed the new sulfur holding. He is offering it to Central Eureka on an actual cost basis.

After exploring the deposit at Sulphur, Nev., the management estimates it could earn a net profit of $500,000 a year for Central Eureka. A refinery will be built shortly.

Celanese Will Produce Vinyl Acetate Monomer

Vinyl acetate will be produced by Celanese Corp. of America in its new Pampa, Tex., plant as soon as additional facilities, now under construction, are completed. Initial production is expected in the third quarter of the year.

Raw materials made by Celanese at Pampa and at its Bishop, Tex., plant will be used to produce the vinyl acetate. Celanese has developed a new process for making the vinyl acetate monomer.

Entry of Celanese provides a second U. S. source, and will about double availability of vinyl acetate monomer.

Erection of the new unit will further diversify the Pampa plant. The unit is designed for stepped-up production if demand warrants.

Vinyl acetate is converted to polymers for use in textile finishes, adhesives and water-based paints. It is also an intermediate for the manufacture of polyvinyl alcohol, polyvinyl butyral and polyvinyl formal. Polyvinyl alcohol goes into textile sizes and paper coatings; polyvinyl butyral into the middle layer of safety glass; and polyvinyl formal into wire coatings. Other commercial uses for vinyl acetate include copolymers for protective coatings, sheets and films, synthetic fibers and soil conditioners.

A potential market for polyvinyl acetate is in water-based emulsion paints. It's expected that the inclusion of polyvinyl acetate will make possible the use of water-based paints for coating exteriors.

Wisconsin Paper Mill Treats Own Wastes

A new plant to reduce stream pollution is now operating successfully at the Whiting, Wis., mill of Consolidated Water Power & Paper Co. The treatment plant handles waste that formerly flowed into the Wisconsin River.

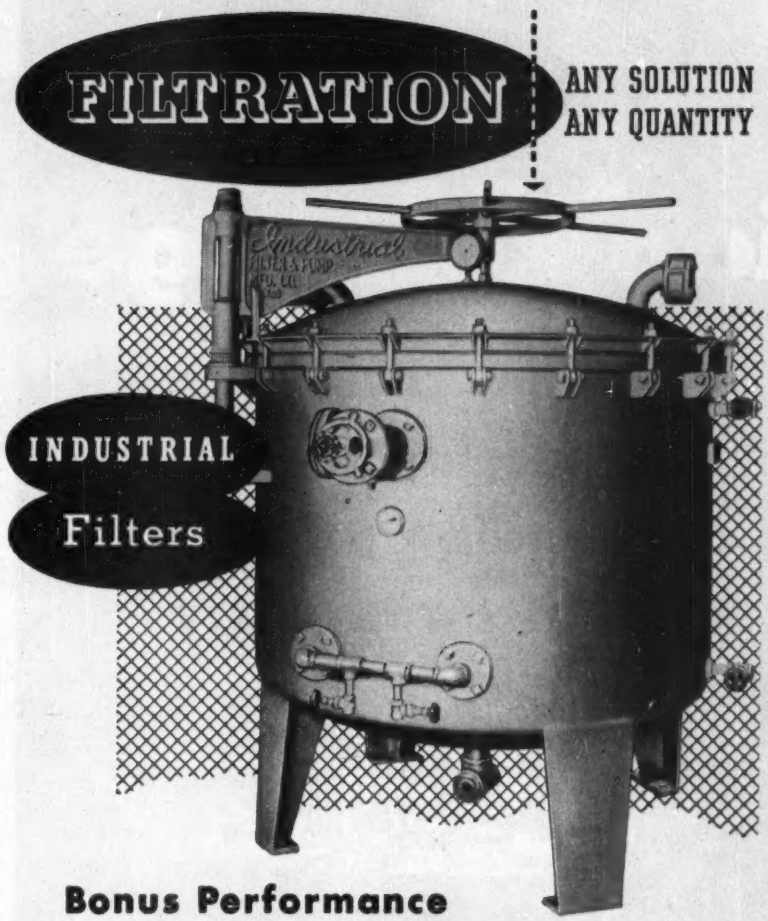
The installation includes an Imhoff primary digestion plant designed for a population of 200 and a daily flow of 24,000 gal., two sludge-drying beds, piping and auxiliary equipment. The new plant cost $35,000.

Municipal treatment facilities are not accessible to the mill at Whiting. Consolidated therefore designed and built a complete sewage treatment plant to meet the needs of its mill and the small surrounding community on its property.

Cyanamid Will Operate Government Pilot Plant

An experimental pilot plant will be built and operated by American Cyanamid Co. at Waterbury, Conn., under contract for the United States government. The unit will be under the supervision of Cyanamid's Stamford research laboratories, and W. C. Zmachinsky will manage the Waterbury operations when they begin.

The nature of the new operations cannot be revealed. It is anticipated that the pilot plant will eventually employ about 75 persons.



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The engineering and construction features of INDUSTRIAL filters add up to maximum clear filtrate with less floor space, greater operating conveniences, and less maintenance delays and expense. The general design permits the use of the materials best suited to the solution requirements. Vertical filter leaves with ample flow space on both sides offer maximum filtration area. Outside lockup simplifies the installation of filter leaf and bag assemblies. An exclusive air-wash cleaning method practically eliminates the usual labor and inconvenience of dismantling the filter after every cycle. INDUSTRIAL filters are often in operation for months without removing the cover — cutting downtime to a minimum. All these features have been proved in long-life service — your assurance of dependable bonus performance.

Full particulars and recommendations on any filtration job will be given upon request.

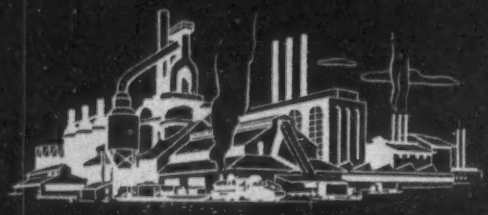
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ILLCO-WAY "firsts" include manufacture of the first commercial two-bed De-ionizer . . . the first commercial mixed-bed De-ionizer . . . development and building of the first successful installation for beet-juice purification by ionXchange . . . and more recently the development of a similar process for the purification of crude glycerol. These and numerous other applications of ILLCO-WAY ionXchange technology are currently available for your products or processes.

ILLCO-WAY

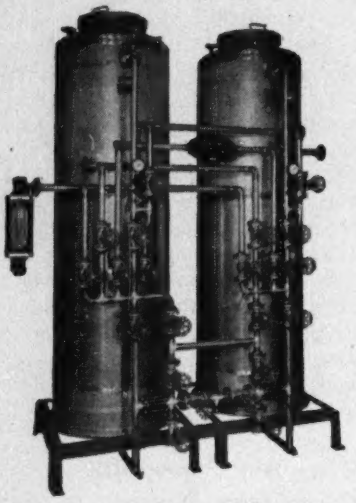
DE-IONIZING
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SOFTENING

For complete data: see Sweet's File, Engineering; or Chemical Engineering Catalog

ILLINOIS WATER TREATMENT CO., 844-5 Cedar St., Rockford, Illinois
141 East 44th Street, New York 17, N.Y.
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ionXchange unit

for removal of acid from Ethylene Glycol



Illco-Way ionXchange unit, designed and fabricated for use in Southwestern chemical plant

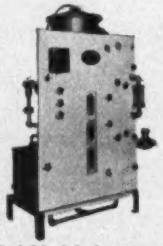
In the manufacture of ethylene glycol, mineral acids used during hydrolysis of ethylene oxide to ethylene glycol must be removed. This is accomplished by anion exchanging the aqueous solution of ethylene glycol.

The acid content is reduced from 0. 15% to 0 acidity by the simple addition of ionXchange equipment to the process. Illco-Way equipment specially developed for removal of acids from organic solutions is seen above—unit fabricated entirely of stainless steel, designed for manual operation.

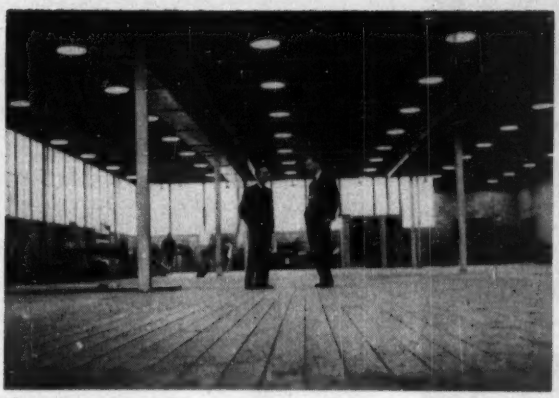
Other examples of the application of ionXchange to purification of organic solutions, developed by Illco-Way research: purification of glycerol (by cation and anion exchange) and purification of chromic acid (by cation exchange).

Improvements and economies in many other manufacturing processes can be effected by ionXchange. Write for Bulletin A. Address: Illinois Water Treatment Co., Rockford, Illinois.

"Package" De-ionizers



ILLCO-WAY offers a complete line of standard (package-type) De-ionizers—for production of solids-free De-ionized Water (flow rates from 100 to 1000 gph). Units are compact, shipped completely assembled and base-mounted. (Mixed-Bed Model shown at right.) Ideal production units; convenient for laboratory and pilot-plant research. Write for Bulletin PK-152. Address: Illinois Water Treatment Co., Rockford, Illinois.



SITE of pit which will contain Kidde's reactor is examined by men who will build it.



Photo courtesy of Newsday

MODEL reactor gets once-over from John Kidde, president of Kidde & Co., and Karl Cohen.

Green Light—Almost—For Power Reactors

Look for the first to be under way within a year. Technology and economics look O.K.; government seems favorably disposed toward releasing some of the reins

We now know enough chemical engineering and related technology to begin building economic, safe and efficient atomic power reactors right now. That's the combined opinion of Karl P. Cohen, vice president and research director, and William Thompson, chief engineer of the country's first privately financed nuclear laboratory—Walter Kidde Nuclear Laboratories, Inc., of Garden City, N. Y.

"The number one, two and three problems are costs," says Cohen, "but we think we can lick them. The rest is basically like any other heat-exchange problem. As far as materials of construction are concerned we expect eventually to get all the zirconium we need at about $15 a pound. And the safety problems associated with building and operating reactors are not as serious as we have been led to believe."

That's the gist of what Cohen told CE's editors in January when the laboratory was officially opened.

▶ **Five More Years**—Cohen went on to say that it will probably be five years before the first power reactor goes on stream. First, the McMahon act has to be changed "to allow private industry to wield the scythe of cost-cutting, profit-making enterprise to the design and construction of reactors." Then it will take two years for design and engineering work, followed by two more for construction.

Present laws notwithstanding, Kidde's timing in opening its new lab is probably just right. Since last summer there has been strong feeling in the Congress that the act which gives the government iron-fist control over all nuclear matters should be reviewed. Very recently, the Joint Congressional committee has been holding a series of confidential meetings with utility and industry groups*, presumably to discuss private industry's role in power generation by atomic reactors.

▶ **How Much?**—Although they weren't free to discuss specific reactor costs, Cohen and Thompson estimated that a 100,000-kw. plant would cost $10-15 million. This figure is considerably lower than the cost of the AEC's reactors, but entirely feasible, think the two men who have been with the atomic program since the Manhattan project.

Thompson contends that a power reactor of the converter type could be used and that the sale of plutonium is not necessary for economic success.

"Consider a 100,000-kw. coal-fired power plant operating at 50 percent load factor with coal at $10 per ton," he says. "If the cost of fuel were completely eliminated (a pound of fissionable material is equal to 1,500 tons of high-grade coal) the plant investment could increase by $12 million with no increase in power cost. Some major fraction of this $12 million will then be available for the additional cost of reactor and processing plant."

One of the big problems associated with building a power reactor would be the safety problem. But Cohen claims that it is far more dangerous to paint radium dails on watches than to work on the controlled release of atomic energy.

▶ **Safety First**—One of the chief safety considerations will be to build a sabotage-proof reactor. To illustrate the problem he points out that using a coolant like liquid sodium—which poisons the nuclear reaction—could be dangerous if the coolant were lost or evaporated. With the controlling effect of such a substance lost, the reaction could exceed the threshhold of safety. On the other hand, if heavy water were used as a coolant, its loss would not be dangerous, since it does not exert any poisoning effect on the reaction.

(Continued)

*Presumably the four industrial teams who have recently completed a one-year study of the AEC's reactor development program from the standpoint of power possibilities and have reported to the AEC on their findings. The teams were: Monsanto Chemical Co. and Union Electric Co., both of St. Louis; Detroit Edison Co. of Detroit and Dow Chemical Co. of Midland, Mich.; Commonwealth Edison Co. and Public Service Co. of Northern Illinois, both of Chicago; and Pacific Gas and Electric Co. and Bechtel Corp., both of San Francisco. Even more recently a fifth industrial team made up of Foster Wheeler Corp. and Pioneer Electric in Pennsylvania has got into the act.

One of the teams, namely Detroit Edison—Dow, has already entered into an agreement with the AEC to extend its study into a second year. The two firms will invest an estimated $250,000 in direct costs for research and development in their own laboratories. It's expected that they will make an engineering evaluation of a dual-purpose production plant of an advanced design.

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Cohen summed up his feelings with these remarks:

"I think we have heard far too much about the difficulties of making useful atomic power; about the difficulties of working under a government monopoly; about the difficulties imposed by secrecy. We have heard far too little about the real progress which has been made.

"The U. S. Atomic Energy Commission has publicly encouraged the participation of American industry in the development of commercial atomic power. Those of us who have been working in the field feel that far more can be done within the framework of existing policy than has yet been done. The goal of my associates and myself in forming Walter Kidde Nuclear Laboratories is to participate, and if possible, to take the lead in this coming development. Although serving industry is our primary objective, we, of course, recognize our obligation to assist in government programs if requested."

New Plasticizers Made by Hydrogen Peroxide Process

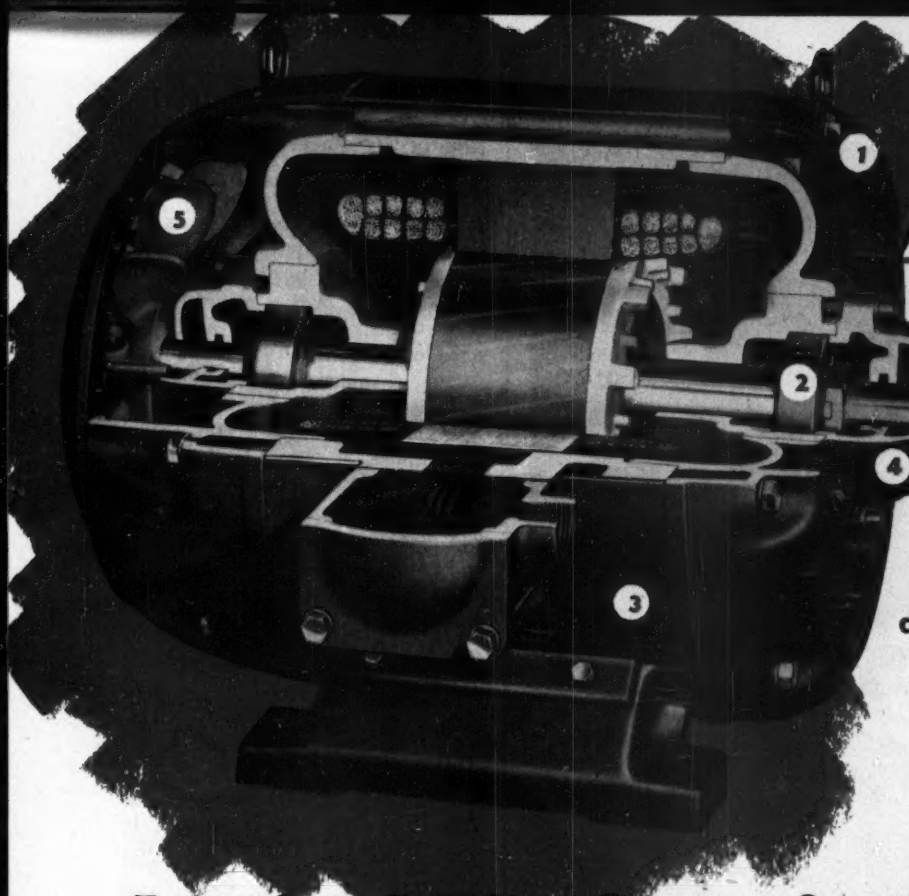
Plasticizers for vinyl plastics are now being made from inedible animal fats and vegetable oils by a process developed by the Eastern Regional Research Laboratory of the U. S. Department of Agriculture in Philadelphia.

A big advantage claimed for these plasticizers made from fats and oils is that they protect plastics containing chlorine from discoloration and weakening caused by the hydrochloric acid formed when the plastic is exposed to heat or sunlight.

Moreover, the new plasticizers do not make plastics opaque or hazy, as lead and cadmium compounds sometimes do when used as modifiers.

The process for making plasticizers from fats and oils involves treatment of the acid portion of these materials with hydrogen peroxide in such a way that a specially oxidized oil results. The process is simple, cheap and practical, and can be used with a wide variety of animal fats and vegetable oils. Hog and cattle fats and soybean oil have been used.

Three companies have been licensed by the U. S. Department of Agriculture to use the new process. The plasticizers are now available in



5-way Protection

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A Louis Allis Chemical Motor protects you these five ways against corrosion:

1. Cast-iron construction. Stator housing, end brackets, and conduit box are cast iron, well-known for its resistance to corrosion.

2. Cartridge-type ball bearings. Motor can be completely disassembled without exposing bearings or lubricating grease to dust.

3. Stainless-steel shell over housing. Non-corrosive shell directs air over housing to cool motor. Shell is easily removed, to clean air passages.

4. Removable bearing caps. Let you examine bearings without dismantling motor.

5. Cast-bronze ventilating fan. Keeps motor temperature down, and is non-corrosive.

Additional features available include: Special Class A or Class B chemical insulation for extreme corrosive conditions or high ambient temperatures; and drain and breather plugs for elimination of internal condensation due to "breathing."

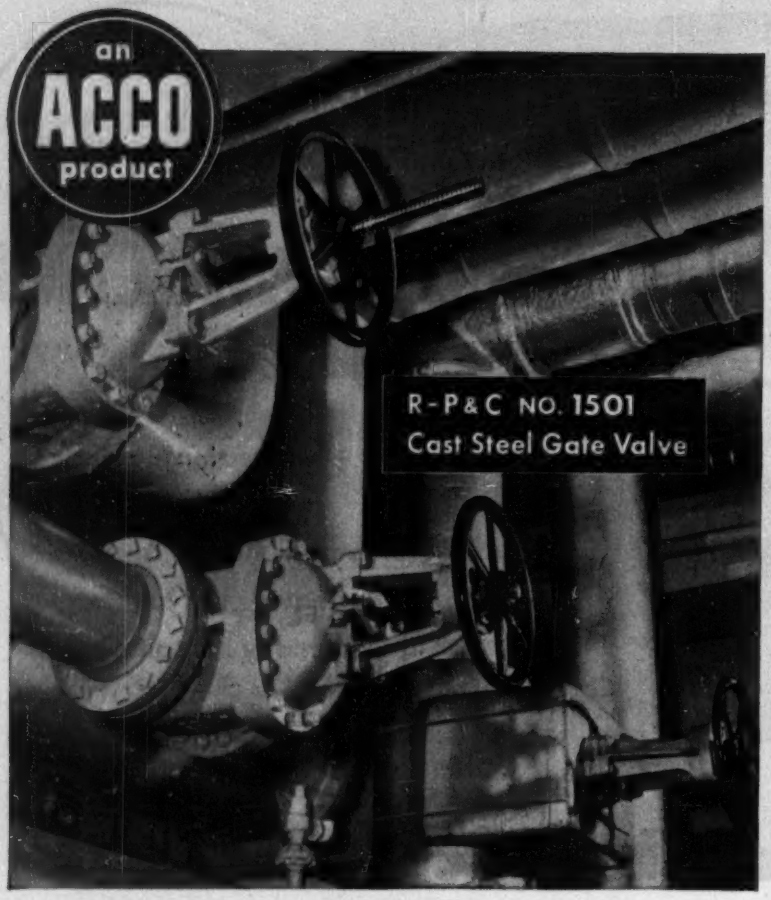
You can get Louis Allis Chemical Motors in NEMA frames 224 through 505 and frame 108 — in standard, enclosed, fan-cooled construction and enclosed, fan-cooled, explosion-proof construction. They carry Underwriters' approval for Class I, Group D or Class II, Group F or G hazardous locations.

Let the Louis Allis engineer help you solve *your* motor problem and cut your maintenance costs. Call him in soon.

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CM-101





How R-P&C Valves Reduce Maintenance Costs

• Six important features of R-P&C Cast Steel Valves eliminate many service troubles which in turn reduces maintenance costs.

First of all . . . they're made from electric furnace steel which means sound castings. All parts are designed for equal strength and great toughness. The bodies resist distortion. Permanent alignment is provided by the rigid one-piece yoke. And the gland packing stays tight even at high pressures and temperatures. Furthermore, the design detail assures smooth flow and positive shut-off.

You can get R-P&C Cast Steel Valves in gate, globe, angle, stop and check, and swing check types. Variety of trim metals for air, gas, liquid, oil, steam, water. Wide range of pressures and temperatures. Screwed, flanged, or welding ends. Sizes range from 1½" to 24".

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R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

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R-P&C valves

tank car lots. Rohm & Haas Co. and Archer-Daniels-Midland Co. are reportedly two of the companies.

A large potential market exists for plasticizers, since more than 150 million pounds is required for the chlorine-containing plastics manufactured each year.

As for raw materials, there is a large surplus of animal fats, byproducts of the meat-packing industry, and the new process represents a step in the Department of Agriculture's search for new uses for them. In 1952, the surplus amounted to about 700 million pounds.

More Ethylene From Gulf For Petrochemical Makers

The huge new $8-million ethylene unit at the Port Arthur, Tex., refinery of Gulf Oil Corp. is now in operation, piping ethylene to Gulf Coast petrochemical plants.

Gulf's new ethylene unit can produce 180 million pounds per year. It is one of the largest of its kind in the country.

Ethylene will go to the Port Arthur plant of Koppers Co., where it will be used to make ethyl benzene. Koppers expects the new $5-million unit to be in full operation early this summer. Its capacity: about 6 million pounds per month of ethyl benzene. The ethyl benzene will be shipped to the Kobuta, Pa., plant of Koppers for use in the manufacture of styrene.

In addition, Gulf will furnish ethylene to the Orange, Tex., plant of Du Pont, to the Houston plant of Ethyl Corp. and to Monsanto at Texas City. The ethylene feedstock will be used by Gulf Coast petrochemical industries to manufacture products ranging from antifreeze to plastics.

Farmers Need Heavy Loans To Pay for Fertilizers

For purchase of fertilizers alone, U. S. farmers will need $400 to $500 million in added working capital between 1953 and 1955. That's the estimate of Vice President W. R. Allstetter of the National Fertilizer Association.

"In view of the cost-price squeeze in which farmers find themselves," says Allstetter, "it appears that the funds for purchasing the additional

fertilizers may well need to be supplied from credit sources. In fact, many farmers who in the past have been able to purchase their fertilizers with their own funds may require some financing just to maintain their past level in purchases."

Lauding bankers for their intelligent backing of greater soil fertility, the NFA's vice president declares that this work can be speeded if bankers get more information on the results of fertilizer use from farmers and fertilizer manufacturers.

Oak Ridge Cyclotron Will Fuse Lighter Elements

A new cyclotron just completed at Oak Ridge, Tenn., will speed up heavy particles, making possible the fusion of lighter elements into heavier ones. According to Union Carbide & Carbon Corp., whose engineers designed it, the new cyclotron opens an unexplored field of basic nuclear research.

The cyclotron was specially designed to speed up heavy particles. Nitrogen gas fed into the cyclotron is first ionized. Then the ionized particles are accelerated by magnets to a speed of 25 million electron volts. This speed makes it possible for the nitrogen ions to combine with particles of oxygen and carbon to form particles of fluorine, sodium and aluminum.

Previously, cyclotrons have been used to break down heavy elements into lighter elements. Carbide built the cyclotron at a cost of $140,000.

Monsanto Now Producing New Methyl Ester of TSA

Methyl toluene sulfonate is being produced for the first time in commercial quantities by Monsanto Chemical Co. It is used for methylation during dyestuff manufacture.

The product is a methyl ester of a mixture of toluene sulfonic acids, the mixture being high in the ortho isomer and low in the para. The new ester is more stable than methyl para toluene sulfonate, which it can replace.

This new compound can be used as a catalyst in making alkyd resins and other organic esters. It can also be used in the manufacture of photographic chemicals and pharmaceutical intermediates.

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You can effectively handle any corrosive liquid or gas by repacking your valves and pumps with "John Crane" Chemlon "C-V" Rings. Molded from the remarkable material, Teflon, "John Crane" Chemlon "C-V" Rings are impervious to almost every known chemical substance. They withstand extreme temperatures from −94° to +482°F—have extremely low friction coefficient. "Breakout" friction is only slightly higher than that of running friction. Special cross sectional design affords positive sealing at practically finger-tight gland pressure.

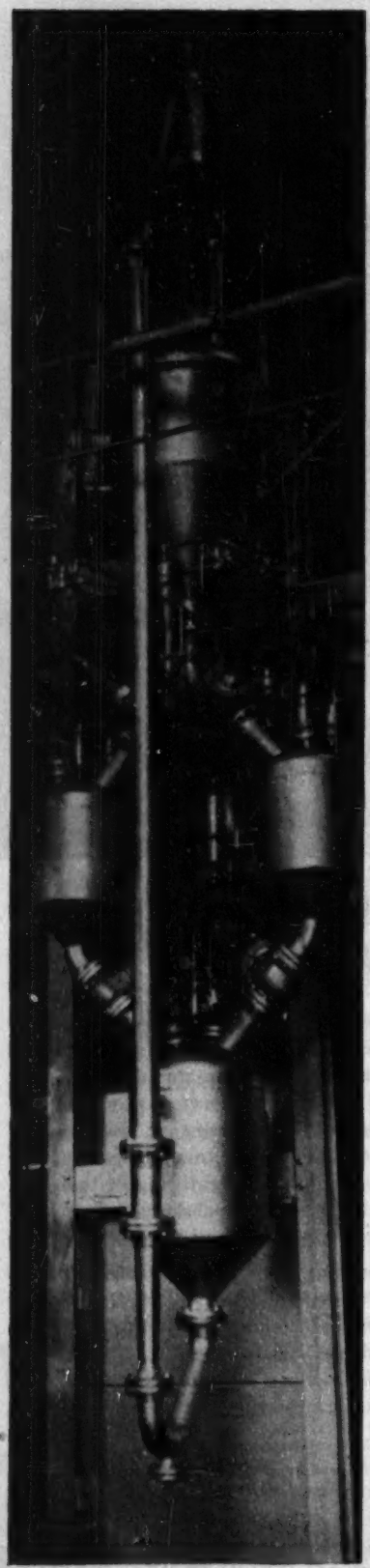
To bring you all the important advantages of Teflon for your particular sealing problem or application, "John Crane" has developed a complete line of Chemlon "C-V" Rings and male and female adapters. If you have special requirements, additional sizes can be molded to fit your stuffing box dimensions.



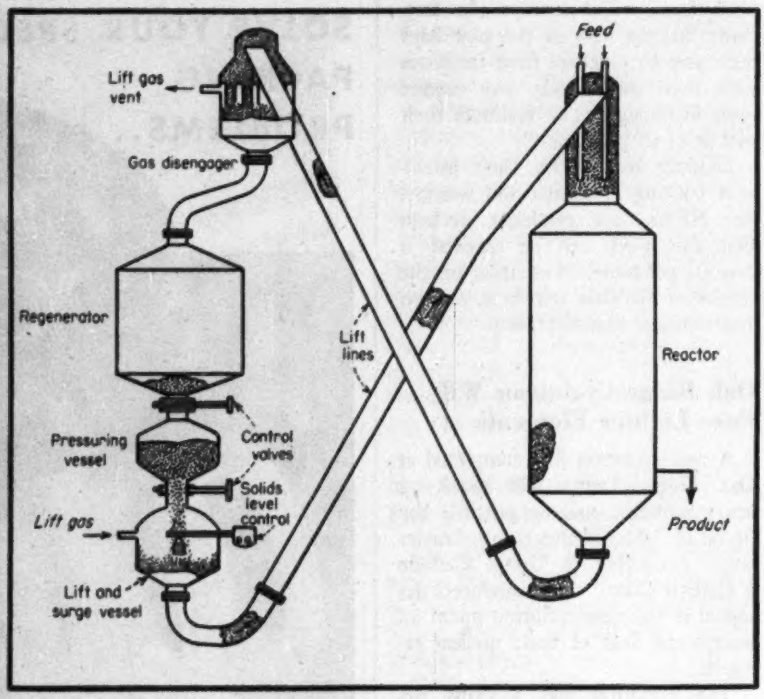
"John Crane's" illustrated booklet "The Best in Teflon" contains extensive information on a wide variety of Chemlon Products. Send for your free copy. Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, Ill.

*DuPont's trademark for tetrafluoroethylene resin

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HYPERFLOW pilot plant.



CONTACT COKING—Typical high pressure application of a . . .

New Gas Lift for Solids

Hyperflow, developed in conjunction with Union Oil Co.'s new Hyperforming process, uses a new principle in solids transport. Many advantages are claimed.

Minimum attrition, high transport rates in small vessels for a wide range of particle sizes and ready adaptability to high temperature and pressure conditions—these are the major claims Union Oil of Calif. makes for its new solids lifting technique, Hyperflow.

Extensive tests at Union's Wilmington, Calif. pilot plant (see cut at left) indicate that the new system can lift pelleted catalyst to the top of the tallest catalytic cracker built to date—about 300 ft. Also, the unit has been operated successfully over extremes of temperature and pressure up to 1,200 deg. F. and 600 psi.

▶ **New Conception**—According to Dr. Clyde Berg, director of Union's development department, Hyperflow represents a new principle in solids motion, involving in essence a gas-solids mixture previously overlooked by investigators. For patent and other reasons, Union is not yet prepared to release all the details on how Hyperflow works, but this much can be told.

Unlike conventional gas lifts where the solid particles are dilutely suspended in a fast-moving gas stream, here the solids move in a compact, unfluidized mass. Since both solids and gas velocities are low, reduced attrition rates are achieved. Smooth overflow of particles at the top of the lift pipe with no free fall further minimizes solids breakage.

Hyperflow uses small volumes of lift gas (less than 10 percent of that used in conventional methods) and comparatively high pressure differentials in the lift leg (50-75 psi. in a 100-ft. lift). Particles ranging in size from dusty carbon black to 1-in. diameter pieces of coke have been conveyed in the pilot plants.

Another important advantage of Hyperflow is that it establishes a positive seal between reaction vessels, preventing escape of vapors. Any lifting fluid, such as air, gas or flue gas, can be used.

In the near future, catalytic crack-



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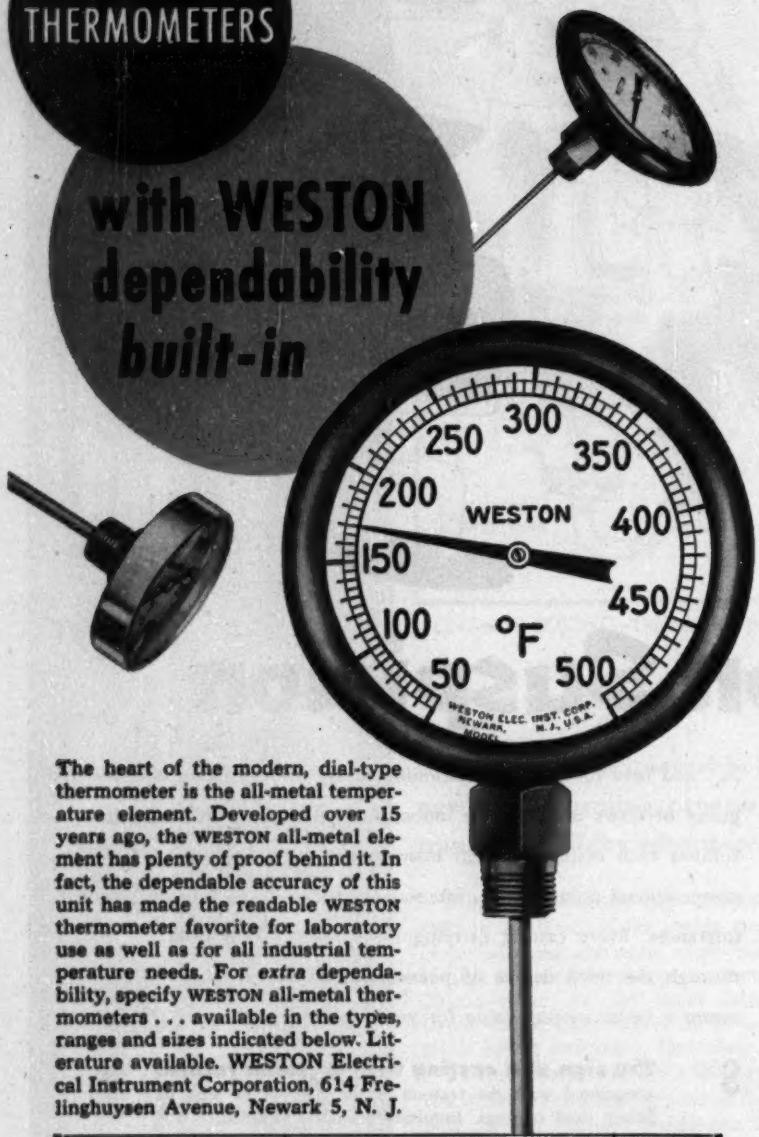
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Type	Scale Length	Ranges		Stem Length		% Accuracy of Thermo. Range
		As low as	As high as	As short as	As long as	
Heavy Duty Straight Form	9"	−100F	+1000F	2½"	48"	1
Heavy Duty Angle Form	9 or 12"	−100F	+1000F	2½"	72"	1
Standard Angle Form	6"	−100F	+1000F	2½"	72"	1
General Purpose	4½"	−100F	+1000F	2½"	36"	1
Laboratory	3.40"	−100F	+500F	2"	24"	½ of 1

WESTON *Instruments*

ing units using Hyperflow will be operating at catalyst circulation rates much higher than is achieved in present bucket elevators and gas lifts. Units now being designed will lift 750 tons per hr. in a 12-in. pipe.

Lummus Co. has been licensed to adapt the Hyperflow principle of materials handling to processes in the petroleum refining and chemical industries. Stevens-Adamson Co. will construct Hyperflow units for use in more common conveying systems.

▶ **Where It's Used**—First commercial installation using the Hyperflow technique is now in operation at Shamrock Oil & Gas Corp.'s 1,000 barrel-per-day continuous contact coking unit at Sunray, Texas. Hyperflow will also be an integral part of Union's new Hyperforming units which catalytically reform distillate stocks to premium gasoline or aromatic chemicals. Union expects that many other uses will be found as industry becomes more aware of the unique advantages of this system.

The continuous contact coking process consists essentially of introducing a residual petroleum stock to a circulating stream of hot coke particles which are produced in the process itself. The continuous method is much more flexible than the more common semi-continuous and delayed coking processes now in use. Very heavy residual asphalts and pitches can be used and manpower requirements are greatly lowered.

Shamrock uses Hyperflow to recirculate the coke from the bottom of the contacting reactor to a feed hopper at the top. Since particle sizes increase as coking progresses, Hyperflow's ability to operate over a wide range of specific gravities is most important.

▶ **Hyperforming**—Biggest projected use of Hyperflow is in Union's own Hyperforming units. This process uses a moving bed of pelleted catalyst circulating at less than 5 tons per hour to reform various naphthas and cracked stocks.

The catalyst, made of a special alumina base impregnated with cobalt and molybdenum oxides, moves at very low velocities (in the range of 1 ft. per sec.) with minimum attrition losses (a 10,000 bbl. per day unit would lose less than 200 lb. of catalyst a day).

A stream of hydrogen is employed

in the reactions, giving high liquid yields and increased octane values from straight-run naphthas or blends of straight-run and cracked stocks. Operating pressure is near 400 psi., and reactor temperatures are in the range of 800-900 deg. F.

Very important to the process is the fact that the cobalt-molybdenum catalyst can handle high sulfur, high-nitrogen and otherwise contaminated stocks without becoming poisoned. Gasoline stocks containing as much as 3½ percent sulfur have been successfully refined.

Union has two Hyperforming units on the drawing boards—one to yield 600 bbl. per day of premium gasoline from straight-run naphthas, and one 12,000 bbl. per day from high-sulfur, cracked naphthas. Negotiations are under way with other interested companies for Hyperformers to produce anywhere from 200 to 12,000 bbl. a day of gasoline from widely varying feed stocks.

Baroid From Texas Plant Goes to Oil Well Drillers

In the new Corpus Christi, Tex., plant of its Baroid Sales Division, the National Lead Co. will process 5,000 tons a month of barite ore, producing drilling materials used by the petroleum industry in sinking oil wells.

Barite ore from Nova Scotia, Europe and Mexico arrives by water at the plant. There the ore is crushed, dried and ground to the required fineness. Then it is stored in a silo with a capacity of 500 tons.

Finished Baroid will be shipped by rail and truck to consumers. It will be furnished either in bulk or in bags.

Primary user of Baroid is the petroleum industry, which requires large quantities of drilling materials to bring rock cuttings to the surface and to perform other important functions.

The heavy weight of finely ground barite ore makes it especially useful for controlling such conditions as extreme gas pressure, often encountered during drilling.

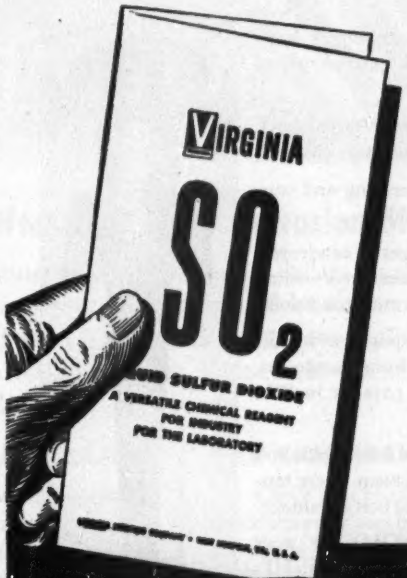
Corpus Christi was picked as the site for the newest plant because of increased drilling activity in the surrounding oil fields. The Baroid Sales Division also has processing plants at Houston and Texarkana. Their production will be coordinated with that at the new Corpus Christi plant and with operations at Baroid's mines.



Millions of pounds on wheels

The need for Sulfur Dioxide (SO_2) may arise in your plant as suddenly and emphatically as that for a six-gun in the old West. When this occurs, call "Virginia," and things will happen fast.

"Virginia" is the world's biggest producer of mobile "ESOTOO" —liquid sulfur dioxide with wheels under it, ready to be rushed to your rescue when you get in a jam. "Virginia" tank cars, trucks, drums, cylinders in ample numbers assure rapid shipment of your order. Our huge annual production of SO_2 and an abundant storage capacity make this unmatched service possible.

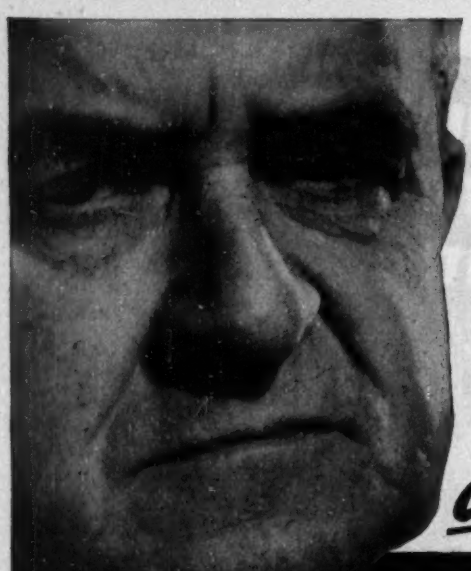


Call upon us also for the technical aid you may need for best results in using "Virginia" Liquid SO_2 in your products and processes. This counsel has proved invaluable over the past 30 years in applying our versatile chemical as a reducing, bleaching and neutralizing agent, preservative and antichlor, and for pH control—in more than 40 diverse industries. Send for the "Virginia" SO_2 folder today.

VIRGINIA SMELTING COMPANY
Box 21, West Norfolk, Virginia

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VIRGINIA Chemicals



"I'm a hard man to convince!"

ACID-PROOF TANTALUM
Chemical Processing Equipment

"But it didn't take me long to discover what a sound, economical investment it was to use Fansteel ACID-PROOF TANTALUM equipment in my chemical operations. These are some of the reasons that convinced me . . ."

Acid-Proof: Not merely "corrosion-resisting." Very few acids, even at high temperatures, have any effect upon tantalum.

High Strength: Tantalum is not subject to thermal shock and will stand the strain of great temperature changes.

High Thermal Efficiency: Heating, cooling and condensing efficiencies are surprisingly high.

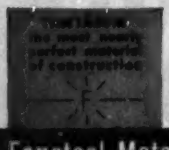
Saves Cooling Water: Tantalum tapered condensers (shown at right) require a minimum amount of cooling water, at all seasons and under all operating conditions.

Maintenance Economy: Tantalum equipment is built for long dependable life, freedom from shutdowns, replacement and repair. It usually pays for itself in maintenance savings.

Fansteel engineers are at your service for consultation on any corrosion or heat transfer problem where tantalum can be used economically to your best advantage.

USE TANTALUM WITH ECONOMY for most acid solutions, corrosive gases or vapors; not with HF, alkalis or substances containing free SO_3.





Acid-Proof TANTALUM

22401

Fansteel Metallurgical Corporation NORTH CHICAGO, ILLINOIS, U.S.A.

Spencer Chemical to Make Polyethylene in New Plant

Moving into petrochemicals, Spencer Chemical Co., already the nation's second biggest producer of synthetic nitrogen, will become a producer of polyethylene. Spencer will build a plant on a 400-acre site near Orange, Tex., to produce 45 million pounds per year of polyethylene.

"In the interest of further diversification and as a result of several years of research in petrochemicals," declares President Kenneth A. Spencer, "the company has decided to enter the ethylene field and to start with the production of polyethylene."

Spencer Chemical has concluded a contract with Imperial Chemical Industries, Ltd., of London, the holder of the basic patents on the polyethylene process. Through this agreement Imperial Chemical has licensed Spencer to use its process, will help in the engineering design of the new Orange plant and will furnish production know-how. This is highly important since production of polyethylene in the United States is currently limited to two of the nation's major chemical companies, both operating under these same basic patents.

Simultaneously, Spencer Chemical is entering into a purchase agreement with Gulf Oil Corp., which will deliver ethylene to the new plant by pipeline from its Port Arthur refinery.

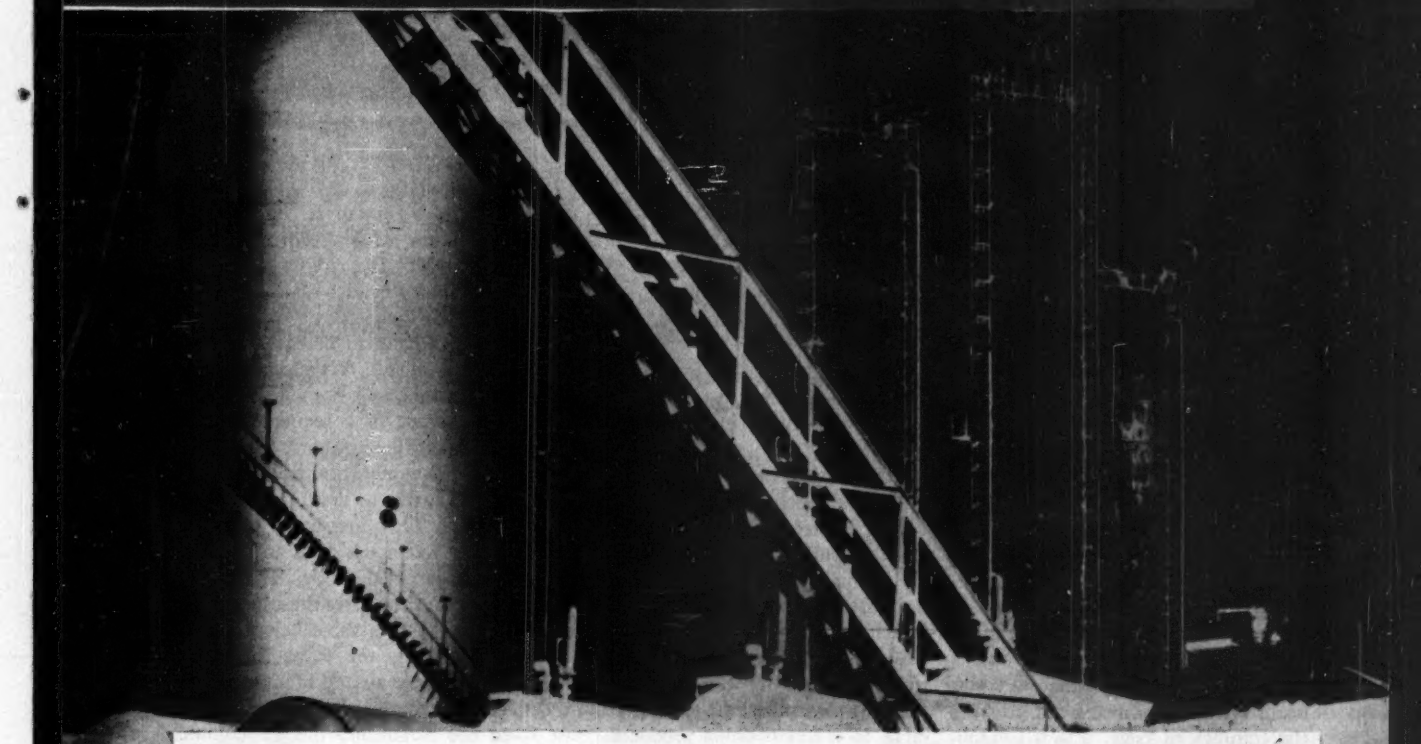
To get additional funds for its venture, outstanding indebtedness will be increased from $15 to $25 million. Added capital thus comes from present holders of its long-term notes. Full amount will be payable in 20 years, commencing Aug. 1, 1956.

Even though polyethylene production is now about 50 times what it was in 1944, it still lags far behind demand. By 1955, when the Spencer plant goes into operation, it's estimated by NPA that national production, now around 125 million pounds annually, should exceed 350 million.

Big present use of polyethylene is in transparent packaging and non-breakable bottles. It can be used for carboys and light, strong, corrosion-resistant piping. Both electrical and coating possibilities are being explored.

Limited production and military demand have hampered its development, but it may become the world's most important plastic in volume.

There's more to CORROSION than meets the eye



Sometimes VISIBLE...Often HIDDEN...Corrosion Strikes in Every Plant

This year, the Chemical Industry will pay millions of dollars for needless losses created by corrosion...*yet much of this corrosion may never be discovered* until it's too late to protect—and time to pay!

Corrosion is readily detected when it appears as rust layers or failing paint on exposed surfaces. But, by far, the major costs of corrosion come from hidden areas—where only minute inspections and constant care can prevent costly failures.

YOU LOSE IN A "WAITING GAME"

Don't wait for rust or other visible signs to appear. Visible or hidden, corrosion will destroy costly equipment... halt production... cause unnecessary maintenance shutdowns... and contaminate valuable products. Thus, corrosion dips deep into your profits as it creates needless losses totaling thousands of dollars.

YOU CAN PREVENT NEEDLESS WASTE

Check your plant for corrosion's presence. Double-check areas that may be vulnerable to *hidden corrosion.* If you would like help, an AMERCOAT Field Engineer will gladly assist you in making a thorough analysis. There is no obligation.

What is AMERCOAT?

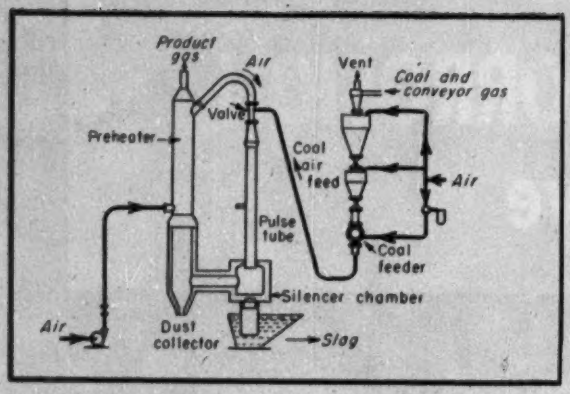
AMERCOAT is a method of corrosion control. Not just a single product, but a complete LINE of coatings individually formulated to solve or control specific industrial corrosion problems.

FOLLOW THE LINE OF [illegible] RESISTANCE...PROTECT WITH Amercoat!

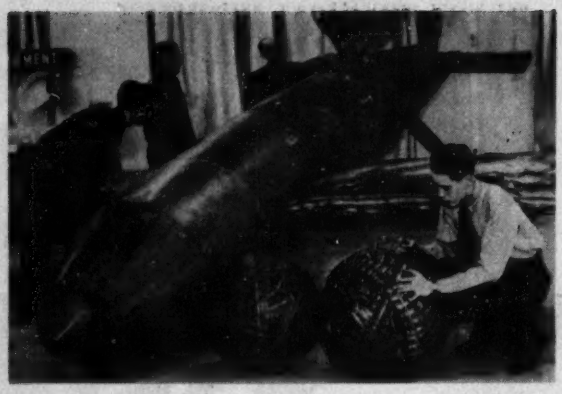
AMERCOAT CORPORATION

4809 FIRESTONE BLVD., SOUTH GATE, CALIFORNIA

CHICAGO, ILL. NEWARK, N. J. JACKSONVILLE, FLA. DALLAS, TEX.



GASIFIER uses pulse-jet principle to get high reaction rates.



BOMB was the first technical use of pulsating gas column.

V-1 Bomb Cues Gasifier Design

Germans use the pulse-jet principle in one of two up-and-coming ways to gasify cheap coal dust. The other, already commercial, is a vortex-type system.

Ruhrgas A.-G., of Essen, Germany, has come out with two very promising ways to use low-grade pulverized coal or coal dust to make producer gas. One, in true popular science tradition, works on the principle of World War II's V-1 buzz-bomb. Although it is still in the experimental stage, its developers are confident that necessary improvements in operation and efficiency are forthcoming.

The second system, based on a vortex or cyclone chamber, is approaching the commercial stage, with a 100-ton-per-day unit under construction. Results obtained on a 15-ton pilot plant are said to exceed those of conventional gas producers gasifying coke.*

The proposed function of these developments in the German economy is to provide a lean-gas replacement for large amounts of higher-Btu. coke-oven gas which is now being used to fire the coke ovens. Coke-oven gas thus released will then be available for pipeline distribution to more exacting applications.

The Germans have conducted their producer-gas tests so far using only air blast. However, the same principles can be used in making synthesis gas or water gas by operating with oxygen-steam blast. And the results should be better because of the increase in concentration of the reactants. Tests with oxygen-steam blast are on the future experimental program.

▶**Advantages**—Raw materials (low-grade fuels such as high-ash fine coals and dust) need no preparation except possibly pulverizing. Bituminous coal of all ranks and types may be used regardless of the caking propensity or other coal characteristics. And the Btu. cost of the gas produced from the cheap fuel is placed at about 25 percent lower than the gas made from coke in a conventional producer.

To exploit the large reacting surface of pulverized coal: (1) temperature in the reactor must be very high; (2) an excess of carbon must be present. These conditions can be achieved in a coal-air system only when the rate of mass transfer is sufficiently high. The usual type of co-current flow pattern, with its low relative velocity between solid and gas, isn't good enough.

The two new gasifiers, however, attain amazingly high capacities and reaction rates. They do it by increasing the turbulence—in the one case with a fast rotating vortex and in the other by high-frequency pulsations.

▶**Pulse-Jet Producer**—This unit is based on the principle of the pulsating gas column which first came to technical application during World War II in the V-1 guided missile. It's extremely simple in design, and its steep increases of pressure and velocity result in fuel rates of about 5.6 million Btu. per hr. per cu. ft. Solid fuel particles show a high relative velocity with respect to the rapidly oscillating gas molecules.

The unit consists of a tube, open at one end and closed at the other by a one-way valve. A fuel-air mixture in such a tube will burn in pulsating combustion or in a sequence of explosions. After the first charge is ignited, the combustion turns into an explosion with a sharp increase of pressure. This pressure closes the valve and forces the gases and air out the open end of the tube. The inertia of the exhausting gases causes the pressure to drop to a value below atmospheric. Thus, the valve is opened again and more air and fuel are sucked in, forming another fresh charge.

In the meantime, the gas column develops a reverse motion, because of the low pressure in the tube, and builds up a new pressure wave by the inertia of the mass of air. The combined effect of pressure, temperature and the free radicals remaining from the previous combustion gas results in a fresh ignition of the charge and the combustion cycle starts anew. The repeated cycle is an oscillating gas column superimposed by intake and exhaust flow.

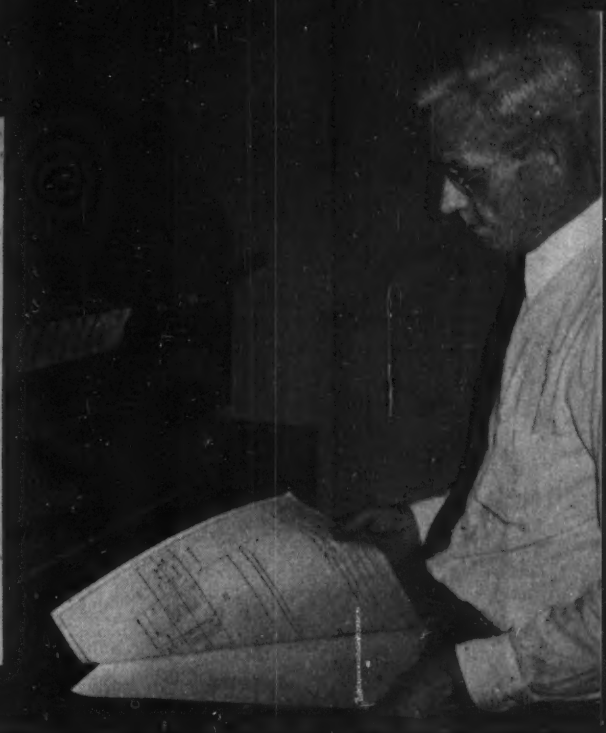
In designing the unit, engineers tested various dimensions, shapes of the tube and types of valves for their influence on frequency, amplitude, fuel rate and permissible fuel excess.

In one of the most recent and successful experimental designs, (see cut) the pulverized coal is charged to the 4-in. ceramic-lined pulsating tube from a bin through a measuring device and a cell feeder. Air is admitted through an aerodynamic (back-flow throttle)

*Reported by Kurt Traenckner, assistant director of Ruhrgas, to the ASME Fuels and Power Divisions in New York last December.

Important savings at Eureka-Williams Corp. because

ALL drawings are reproduced on Kodagraph Autopositive Paper



Positive photographic intermediates are produced *directly*, without the negative step. A standard print-making machine is used for exposure; standard photographic solutions for processing. A fast, easy room-light operation *that saves time and money!*

In print production . . . no wear-and-tear to valuable originals. The Eureka-Williams Corp., Bloomington, Ill., protects its ever-growing investment in drafting time and dollars by using low-cost Kodagraph Autopositive intermediates to obtain the desired number of shop prints. These intermediates, unlike the original drawings, will not smudge or lose line density with repeated printings . . . will produce highly legible prints time after time. Furthermore, their dense photographic black lines and evenly translucent base permit running the prints at uniform, practical speeds. *Which adds to the convenience—and the economy.*



In drafting . . . revisions made 7 times faster. The basic designs for Eureka-Williams oil burners, furnaces, and vacuum cleaners are being modified constantly for the production of various models. Here's just one way Autopositive is used to boil 3 days of drafting time down to 3 hours—

1. An Autopositive intermediate is made of the drawing which is to be revised.
2. The draftsman deletes the unwanted parts of this print with a razor blade.
3. From this, another Autopositive intermediate is made.
4. Then the draftsman only has to add the new design . . . and a new "file original" is ready. From it, additional Autopositives can be made for print production.

Costs are also cut by making Autopositives of office records, and other non-translucent records which are unsuitable for use as print-making masters.



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Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new illustrated booklet, "New Short Cuts and Savings."

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Company _____

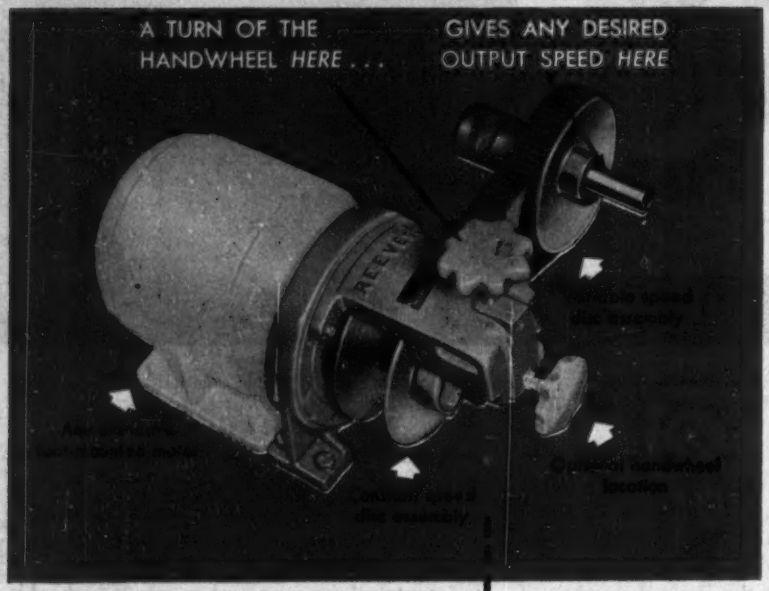
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Kodak
TRADE-MARK

NEW! REEVES
Flexi-Speed Drive

Mounts in any position . . . drives in any direction . . . gives any speed within 8:1 range. *Low Price!*



New REEVES Flexi-Speed Drive is the most versatile variable speed drive on the market today. Drives in any direction. Mounts in any position—above, below or beside the driven machine—practically without limitation. Speed control handwheel and driven shaft may be located anywhere around the motor shaft. Six different length belts offer a wide choice of shaft center distances.

For all these reasons, REEVES Flexi-Speed Drive is the easiest, most practical, and economical way of converting any constant speed motor to an infinitely variable speed drive *with 8:1 speed range*. May be used with any standard ball bearing, foot-mounted motor of ½, ¾ or 1 hp. Identical in working principle to the time-tested REEVES Motodrive, the Flexi-Speed Drive consists of constant speed disc assembly, variable speed disc assembly, double-cog belt and versatile shifting mechanism.

REEVES Flexi-Speed Drive is ideal for driving to standard gear reducers for parallel drive, on worm gear reducer for inexpensive right angle drive. Its versatility assures maximum production with the greatest efficiency and economy in your machines. Write today for complete details. Specify Dept. CE90-V532.

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

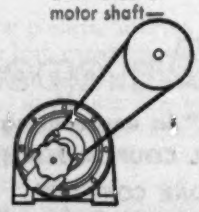
Some of the mounting positions



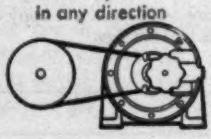
Handwheel control may be located anywhere



360° around motor shaft—



Belt may drive in any direction



REEVES SPEED CONTROL

valve after being preheated by the product gas. In starting up a test run, the apparatus is first brought up to temperature (2,200-2,300 deg. F.) by pulsating combustion with gas, then switched to operation with pulverized coal.

Slag runs down the walls and collects in a pool, from which it is removed at intervals or continously. Dust that has not completely reacted is carried out with the gas, and is separated from the gas in a dust collector for recycling.

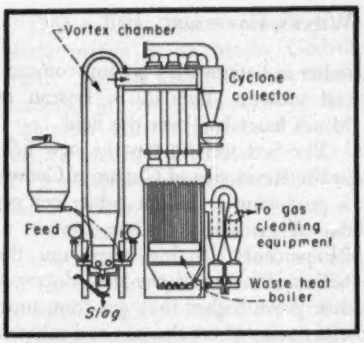
Results from the 4-in. tube haven't been reported, but with a 1½-in. tube Ruhrgas got producer gas with heating values as high as 107 Btu. per cu. ft. and a gasification efficiency of 63 percent.

▶**Vortex-Chamber Producer**—In the commercial plant now under construction, pulverized fuel and highly preheated air will enter tangentially through six tuyeres into the cyclone or vortex chamber. The walls will collect liquid slag which will flow continously out of the central opening of the flat bottom to be granulated by a water bath.

The dust-laden gases will be partially cleaned in a hot cyclone separator before being passed through a blast preheater and a waste-heat boiler. Separation of the dust will then be completed in a multi-cyclone dust collector, a washer and an electrostatic precipitator.

It's the high heat release which allows operation of the reactor with liquid-slag removal, with preheating of the blast air up to 1,100 deg. F. Tapping of the slag in liquid phase is an essential feature of the process, since about 20 percent of the fuel is recycled in order to maintain adequate carbon concentration in the reactor. Because of the efficient slag removal, the recirculated fuel does not carry much higher ash content than the raw fuel. The process enables a complete consumption of the fuel.

The sensible heat of the gas is utilized to preheat the blast. Special precautions are taken to avoid excessive temperatures by close temperature control through gas recirculation. Furthermore, the waste-heat boiler is designed to produce just the amount of steam required for driving the compressor that delivers the coke-oven gas into the pipeline.



VORTEX-CHAMBER promises efficiencies greater than those of Winkler producers.

As far as fuel size is concerned, the process is not at all sensitive. The fuel can be a dust such as ordinarily results from the dedusting operation in coal-preparation plants, so that no pulverizing is required.

A 15-ton pilot plant operating on high-volatile bituminous coal can make 112-Btu. gas with a cold-gas efficiency of 63 percent and a thermal efficiency of 72 percent.

The commercial plant is expected to reach 70 percent cold-gas efficiency. Economically speaking, this is a satisfactory result, considering the low grade fuel used. Even without recirculation of carbon, Ruhrgas claims efficiencies greater than those of Winkler producers.

Alkylation Unit For Refinery in Wyoming

A new alkylation unit will be added to the Casper, Wyo., refinery of Standard Oil Co. of Indiana. The unit will have a capacity of 700 bbl. per day. M. W. Kellogg Co. will start construction this summer, and the alkylation unit should be ready to operate by May 1954.

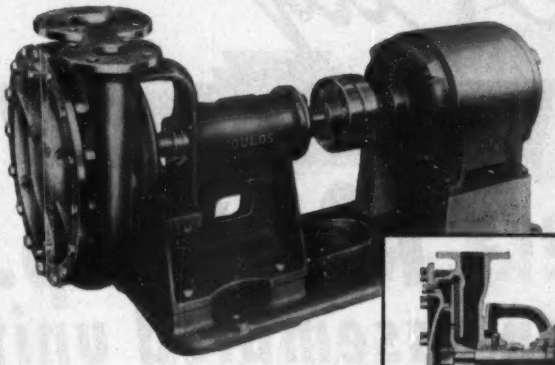
The new unit will be integrated with present refining operations at Casper. Alkylate, produced by a catalytic process that joins lighter hydrocarbons together to produce heavier products, is used in high-octane aviation gasoline blends.

Other Casper refining units, built during the expansion and modernization completed in 1949, will continue to operate. These include the catalytic cracking unit.

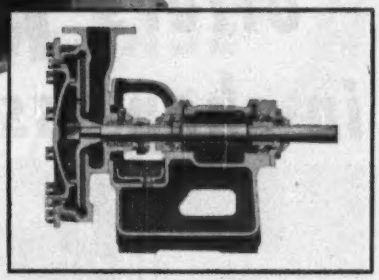
Rich Source of Helium Found in Oklahoma

Helium has been discovered in Oklahoma's Cimarron County, and gas from the newly discovered field may be

Cut Costs in Handling Corrosives . . .



GOULDS Fig. 3705
Removal of casing cover permits interior inspection and cleaning. Capacities to 600 G.P.M. Heads to 160 ft.



Goulds CENTRIFUGAL CHEMICAL PUMPS

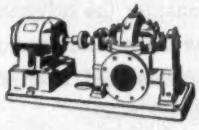
Other GOULDS for General Industrial Use



GOULDS Fig. 3169
Single stage centrifugals for general processing purposes. Capacities to 1100 G.P.M. Heads to 180 ft.



GOULDS Fig. 3047
Vertical sump pump with nonclogging impeller for water containing large solids or fibrous materials.



GOULDS Fig. 3405
Highly efficient, compact new pump for all general liquid handling applications. 19 sizes. Capacities from 200 G.P.M. to 6400 G.P.M. Heads up to 260 ft.

Here's how an alert plant engineer cut pumping costs by 75%: When the pumps he was using to handle a highly corrosive liquid wore out, he replaced them with Goulds Centrifugal Chemical Pumps, *costing only one-fourth as much.* The Goulds pumps have already lasted *twice as long* . . . and they're still going strong.

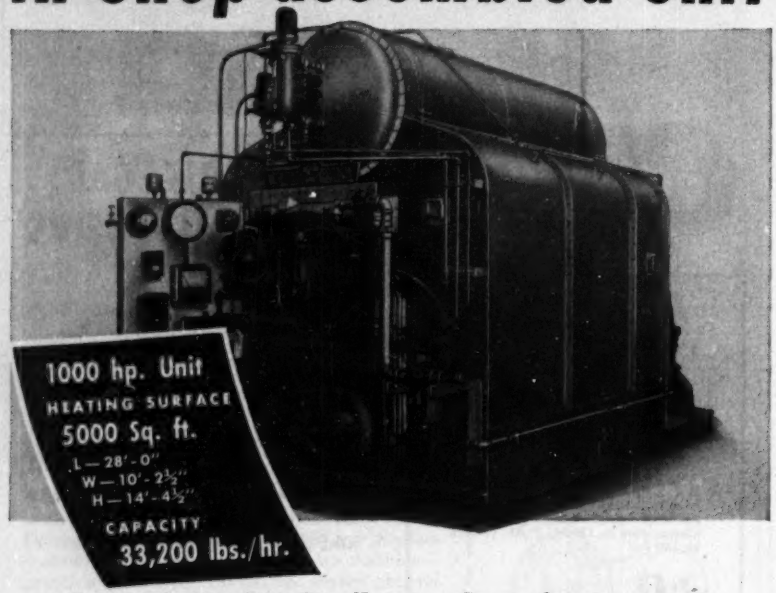
Sturdy Construction Means Long Wear

The entire fluid end of this pump is made of stainless steel and mounted on a cast iron support. Other material and alloys can be supplied for wetted parts. With the stuffing box on the suction side, pressure on it is limited to the suction head only, assuring long packing life and freedom from excess leakage. Interchangeable parts assure reduced inventories. For complete information, contact your nearby Goulds representative or write for Bulletin 725.3.

MEMBER

Goulds PUMPS INC.
Seneca Falls
New York

Erie City KEYSTONE offers 1000 Hp. in shop assembled unit



Do not confuse Erie City Keystone Steam Generators with small fire tube packaged units. Keystones are husky, well proportioned 2-drum water tube boilers with center firing. They are either oil or gas, or combination gas and/or oil fired. They are rated like any larger water tube boiler. You can move in a Keystone Steam Generator for 2490 to 33,200 pounds of steam capacity per hour. Consider the advantage of adding automatic steam generators without costly building or tearing down—Keystones are complete and need only service connections. Write for Catalog SB38CE-5.

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Every *Keystone* is test block fired before shipment with the burner and fuel selected.

ERIE CITY KEYSTONE

14 STANDARD SIZES 75 THRU 1000 HP.

You can depend on ERIE CITY for sound engineering

richer in helium than present commercial sources. The U. S. Bureau of Mines has taken over the field.

The first well to tap the new field in the Keyes area of Cimarron County is producing 2 million cubic feet per day of gas with a helium content of 2¼ percent. If this keeps up, the helium content of the new discovery may prove higher than gas from most other areas where the rare and valuable element is produced commercially.

Known as the North Sturgis field, the new pool is northeast of Boise City and west of the huge Guymon-Hugoton gas pool.

Coltex Corp., operator of the first well, is getting gas containing helium at 4,533 ft. in the Keyes sand. Other oil and gas wells have been completed in the Keyes area, but there have been no reports of helium.

The Bureau of Mines operates the largest helium plant in the world near Amarillo in the Texas Panhandle. The content of helium in natural gas there is about 1 percent.

New Process Turns Out Non-Metallic Drier

A pilot-plant method for the manufacture of a non-metallic drying agent for paints, varnishes, inks and linoleum print paints has been developed by Gordon K. Wheeler of the R. T. Vanderbilt Laboratories. The compound is ortho-phenanthroline, one of the few organic compounds that exert a polymerizing effect on coating materials.

Wheeler worked out the difficult synthesis of the compound through a series of reactions, one of which involves the use of about 10 lb. of glycerine per pound of final product.

Used in paints and inks, the compound reportedly decreases the amount of scarce or critical metallic driers required. It offers the further advantage that it does not lose its drying power on aging as some metallic driers do.

TVA Closes Akin Plant as Phosphate Is Exhausted

The Tennessee Valley Authority is closing its Akin plant at Columbia, Tenn., after exhausting the high-grade phosphate supply in that area. The Akin plant has been in operation for 10 years.

TVA will continue to process phosphate matrix in its nearby Godwin plant. Mining and other operations centered at the Godwin plant near Columbia will continue, and the unwashed matrix will be used directly in TVA's fertilizer operations at Godwin and at Wilson Dam.

Phosphatic material to be used next at Godwin is of a type unsuited to the washing process. Elimination of washing will prolong the life of the phosphate reserves of TVA since waste occurs in washing.

CONVENTION CALENDAR

American Institute of Chemical Engineers, joint meeting with Chemical Institute of Canada, Royal York Hotel, Toronto, April 26-29.

First Iowa Thermodynamics Symposium, heat and mass transfer, State University of Iowa, Iowa City, April 27-28.

American Oil Chemists' Association, annual meeting, Roosevelt Hotel, New Orleans, May 4-6.

Society of the Plastics Industry, annual meeting and conference, cruise to Bermuda, May 9-15.

American Institute of Chemists, annual meeting, Philadelphia, May 12-13.

Second Industrial Council, social impact of U. S. chemical industry, Rensselaer Polytechnic Institute, Troy, N. Y., May 15-16.

Chemical Specialties Manufacturers Association, midyear meeting, Drake Hotel, Chicago, May 17-19.

Armed Forces Chemical Association, annual meeting, Waldorf-Astoria Hotel, New York, May 20-21.

American Leather Chemists Association, annual meeting, Netherland Plaza Hotel, Cincinnati, June 7-10.

Manufacturing Chemists' Association, joint meeting with SOCMA, Greenbrier Hotel, White Sulphur Springs, W. Va., June 11-13.

Synthetic Organic Chemical Manufacturers Association, joint meeting with MCA, Greenbrier Hotel, White Sulphur Springs, W. Va., June 11-13.

American Plant Food Council, annual meeting, The Homestead, Hot Springs, Va., June 11-14.

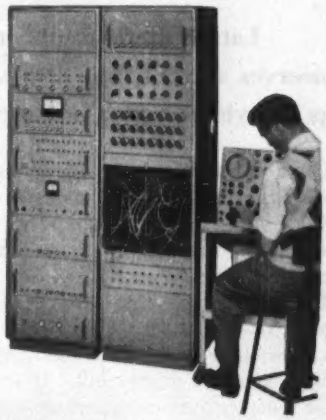
National Fertilizer Association, annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., June 15-17.

American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, June 29-July 3.

working with differential equations?



*Electronic Analog Simulating Equipment



Typical low-priced EASE COMPUTER installation showing 20-channel operational amplifier and power supply, 2-channel function generator, 3-channel function multiplier, typical variable component and over-voltage panel, 30-channel problem board.

SOLVES HIGH-ORDER EQUATIONS IN 1 TO 2 HOURS . . . when solution of relatively high-order differential equations is a customary part of your research or engineering work, the EASE computer can quickly pay its way. Solution time for equations up to the 20th order, *including set-up,* is only one to two hours!

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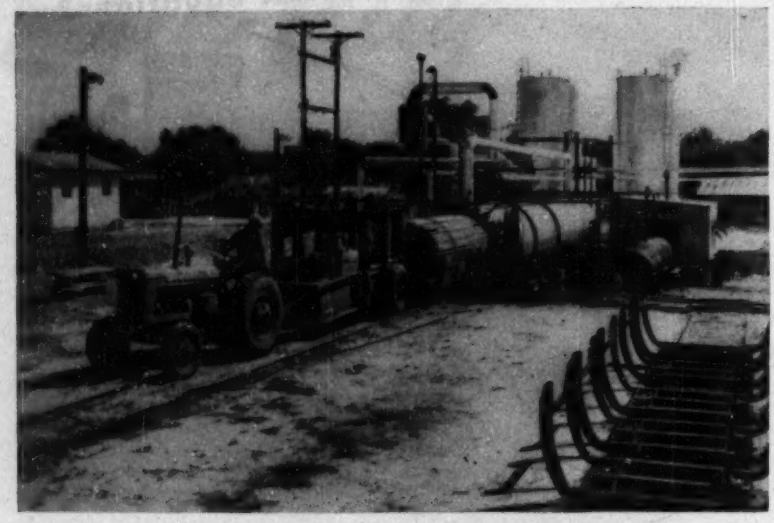
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M-9



Solvent Recovery Cuts Costs

Latest method of pressure-treating wood not only conserves solvent, but also saves preservative, reduces time lags and yields better lumber.

Quite often one good engineering development immediately opens the way to others equally good. That's just what's happening in the wood-preserving industry.

By a simple change in its successful vapor-drying process*, Taylor-Colquitt Co., Spartanburg, S. C., has substantially lowered its solvent bill. At the same time, the new procedure corrects one of the biggest shortcomings of pressure-treated woods—poor paintability.

The new vapor solvent-recovery process uses alternate vapor-heating and vacuum-flashing cycles to vaporize the solvent that's trapped in the wood during preserving operations. Speed plus practically complete recovery of solvent make it much superior to other methods.

▶ **Early Problems**—When oil-soluble wood preservatives, such as copper naphthenate and pentachlorophenol, were introduced to the lumber industry, it was assumed that they would act like the water-soluble salts already in use. Wood preservers thought that wood so treated would be clean and paintable, and, because of water insolubility, that no preservative would leach out with use.

This proved to be wrong. These preservatives had considerable tendency to migrate to the surface while the solvent was being evaporated; they also tended to soften up such natural extractives as resins, which bled out and made satisfactory painting almost impossible.

To make matters worse, the volatile solvents lost from the wood in air-drying after treatment represented a sizable part of the treating cost.

▶ **Steaming No Good**—In trying to lick these problems, wood-preserving companies looked into several conventional solvent-recovery methods.

Alternate steaming and vacuum cycles reduced solvent retention in the wood to about 1 lb. per cu.ft., but that still wasn't enough. Substitution of oven heating for steaming proved no better, and in both cases paintability of the finished wood was poor because of a heavy encrustation of pentachlorophenol crystals on the surface (known as blooming).

Antiblooming agents, such as plasticizers, were added to the treating solution in efforts to improve paintability. They worked fine, but treating costs soared.

▶ **Hudson's Discovery**—Then, Monie S. Hudson, research chemist at Taylor-Colquitt, came up with the vapor solvent-recovery process. Excellent paintability was achieved, solvent retention was lowered to ¼ lb. per cu.ft. and treating costs were reduced as much as 56 percent (see table.) In addition, the wood is virtually stress-free. This means that progressive checking and splitting is greatly reduced.

Solvent Removal Costs

Basis: Southern pine impregnated with pentachlorophenol $/1,000 board ft.

	Solvent Recovery	Steaming	Air Drying
Solvent	$0.48	$1.92	$15.39
Pentachlorophenol	4.37	5.25	6.66
Antiblooming agent	None	3.75	4.76
Solvent removal	7.50	5.50	1.50
Total	$12.35	$16.42	$28.31

By utilizing vapor drying and vapor solvent recovery, Taylor-Colquitt can start with green lumber and turn out an impregnated product, free of solvent and with less than 10 percent moisture in about 19 hours. This compares to times up to 6 months for air-dried lumber.

Both pressure-treating and vapor solvent recovery can be carried out in the vapor-drying vessel. This is simply a cylindrical chamber with an attached condenser.

In the pressure-treating step, an initial air pressure of 40 psi. is established in the cylinder. A solution of pentachlorophenol in xylol is added and the pressure is raised to 100 psi. over the period of an hour. This pressure is held for another hour and then released. The cylinder is emptied of treating solution and a vacuum of 24 in. Hg is applied for an hour. Breaking the vacuum completes the pressure treatment.

Vapor solvent recovery follows. First, the impregnated wood is heated in xylol vapor. Fresh xylol is pumped into the cylinder to a level of about 10 in. Steam coils are used to vaporize it.

Vapor condenses on the wood, dissolving excess preservative from the surface. Condensed xylol drips back to the bottom of the cylinder, carrying with it dissolved pentachlorophenol, which, since it's relatively non-volatile, remains in the bottom when the solvent revaporizes.

The heat of condensation raises the temperature of the contents to about 260 deg. F. in an hour, by which time considerable heat has been stored in the wood. This stored heat and a vacuum of 24 in. Hg are used to flash-vaporize the xylol retained in the wood during pressure-treatment. The vac-

*For removing moisture from green wood. See *Chem. Eng.*, June, 1951, p 115.



Because the Cameron Lift-Plug Valve effects a pressure-tight seal without the aid of lubricant, it is particularly desirable in services where the line product may have an affinity for valve lubricant, and where contamination of the product is undesirable. Tetraethyl lead is a case in point.

Also, many operators have switched to Cameron Non-Lubricated Lift-Plug Valves in order to prevent fouling the orifice plates in metering equipment.

The Cameron Valve is revolutionary in design. It has established new performance records in such services as: Corrosive chemicals, high working pressures, vacuum, and elevated temperatures. Try a few of these valves at the problem points in your plant for first-hand performance data.

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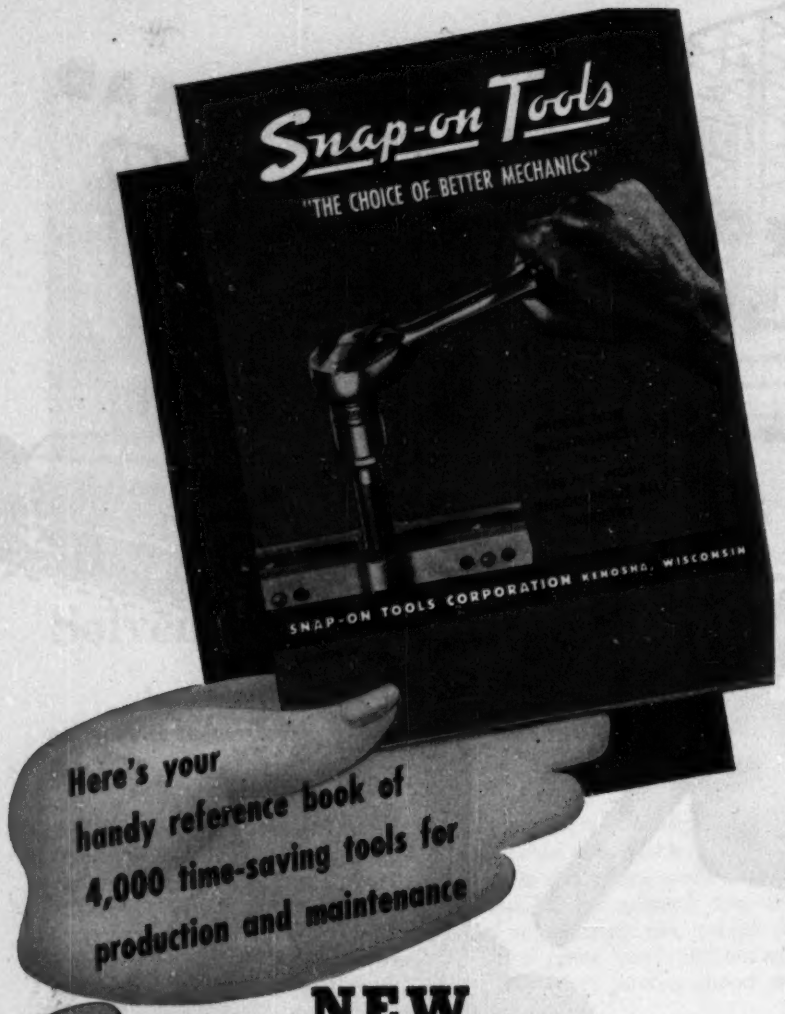
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uum is held for an hour with all external heat shut off.

At the end of the vacuum cycle, heat is again applied with steam coils for an hour, and then the solution is pumped to a "used solvent" tank. A final vacuum cycle completes the process.

Subsequent solvent-recovery cycles employ "used solvent" instead of fresh. The pentachlorophenol concentration is allowed to build up until it's high enough to be used as the pressure-treating solution.

▶ **Improved Distribution**—The pentachlorophenol content of the finished wood is about ¼ lb. per cu.ft. as compared to ¾ lb. before solvent recovery.

And this lower preservative content gives better protection because far more uniform distribution of preservative through the wood is attained by the new process than by either steaming or air-drying.

Comparative paintability tests carried out over a year showed that the preservative in solvent-recovered wood has practically no tendency to bleed through the paint, while air-dried or steam-treated woods discolor the paint badly.

Many different solvents have been used successfully in this process, including Stoddard solvent, VM&P naphtha, xylol, toluol, high-flash coal-tar naphtha, perchloroethylene and trichloroethylene. Economics favor mixed solvents that can be obtained as fractions with moderately narrow boiling ranges, rather than pure compounds.

Specifications Not Enough In Picking Digester Steel

When trying to lick corrosion in processing equipment, don't rely solely on standard specifications for steels. That's the warning H. F. Peters, technical service engineer of Lukens Steel Co., sounded to pulp and paper engineers recently.

Use of specification numbers alone is insufficient, Peters warned, when evaluating the comparative performance of steels in corrosive service, such as in pulp and paper digesters.

As a result of new and better steels, the pulp and paper industry has access to more steel specifications than ever before. Even so, Peters insisted, "The only sound method of proce-

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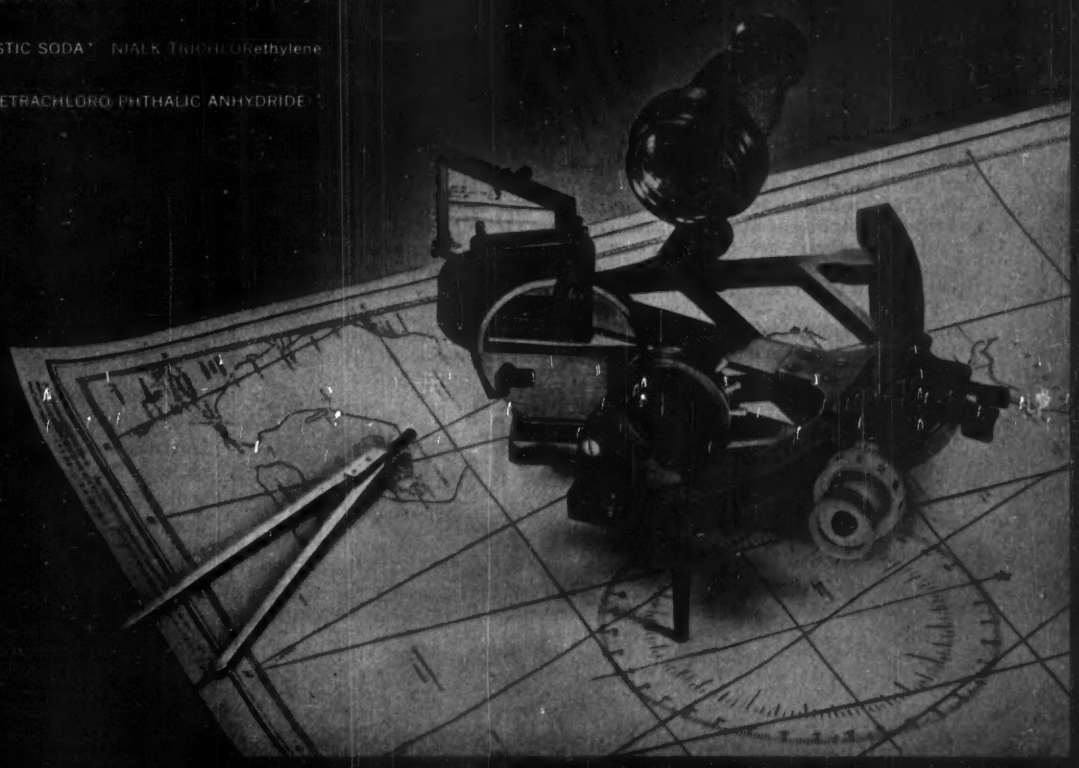
Unsurpassed purity has won for NIALK Carbonate of Potash unqualified acceptance in many industries. Among these is the food industry, where Carbonate of Potash is used in the "Dutching Process" to impart to fine chocolate a distinctive bittersweet flavor.

Constant research, strict quality control and a knowledge of the needs of industry have made this NIALK product—like every NIALK product—second to none in its field.

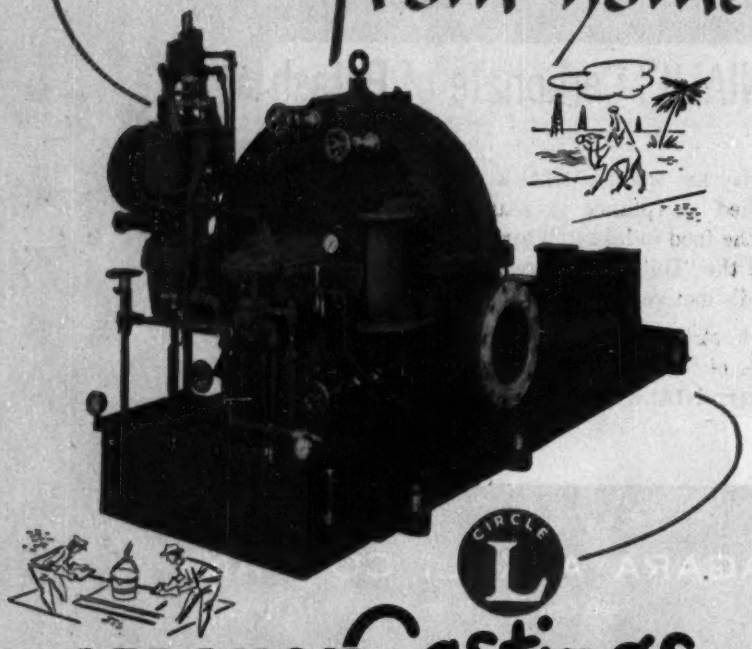
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Operating at 280°F., 450 pounds pressure, the turbines, which are among the largest natural gas turbines in the world, develop a mighty 1940 H.P. at 4400 R.P.M. Terry Steam and their customer, the Arabian-American Oil Company, know that satisfactory service is doubly important when replacement parts are thousands of miles away and repairs are costly. You can be sure that these factors figured prominently in the selection of Circle L Steel Castings, products of true craftsmanship.

You should see — STEEL WITH A THOUSAND QUALITIES — A 37-minute 16 mm full color sound film on the making of steel castings. For information write: Dept. F, Lebanon Steel Foundry.

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dure on which to base a corrosion study would be to have the plate steels in question chemically analyzed."

The problem of corrosion in pulp and paper digesters is one of growing importance and increasing complexity to the paper industry, according to Peters. His conclusions result from continuing study of corrosion problems and development work being done on materials for digester service at the Coatesville, Pa., engineering laboratories of Lukens Steel.

As a major producer of digester, specialty and other steels, Lukens is directly concerned with new developments in the pulp and paper industry. Peters showed the significance of such steels as "killed," "semi-killed" and "rimmed" to modern fabricating methods and digester corrosion problems.

Depending on the methods used and the extent, "killing" tends to impair the corrosion resistance of the finished steel plate in certain kinds of digester service. Certain specifications do not tell the user how the chemical content of the steel will be affected by deoxidation.

Lummus to License Shell's Ethylene Oxide Process

Ethylene oxide is manufactured by the direct oxidation of ethylene in a process devised by Shell Development Co. Ethylene glycol is produced by the hydration of the ethylene oxide. Lummus Co. has been authorized to offer use of the Shell process in the United States.

This process results from several years of work by Shell. It is now ready for commercial use.

Lummus is ready to provide information on yields, investment and manufacturing costs.

New Producer to Turn Out Resorcinol by Own Process

Seeking diversification of products, the Augusta Chemical Co., Augusta, Ga., will begin production of resorcinol. New equipment will be installed at the plant. The company has developed a new method of production that saves raw material.

Production will begin this June, and the total output will be about 1 mil-

lion pounds annually. Augusta Chemical has done considerable research and development toward perfecting its new process.

President Henry I. Gilbert says the company is also increasing production capacity for naphthols, used to produce bright colors in dyeing and printing processes.

Augusta Chemical will also expand its beta oxy naphthoic acid plant. This is the second expansion since capacity was doubled in 1950. New equipment now being installed will give the company a total output of 750,000 pounds a year, three times what it was in 1950.

Supersonic Speeds Reached With Rocket Fuel in Tests

A rocket engine, designed and built by North American Aviation, Inc., has been used to drive a test sled over rails at more than 1,500 mph.—twice as fast as sound.

Using an oxygen-alcohol fuel to generate 50,000 lb. of thrust, the rocket engine can accelerate the sled from a dead stop to over 1,500 mph. in 4.5 sec. while traveling 5,500 ft.

The liquid fuel, North American says, has an advantage over solid fuels in its ability to operate over much wider temperature ranges in all kinds of weather.

A test run using the liquid fuel power plant costs about $100 compared with the $5,000 cost for a similar test with a solid propellant unit.

The rocket engine will run up to 8 sec. with one fueling, and refueling is almost as easy as gassing up an automobile. The engine and sled are being used by the Air Force to test parachute designs for supersonic jet airplanes and to determine the effects of high speeds on humans.

Newsprint From Hardwood Made by Pressure Process

Newsprint is being made from hardwood at the Millinocket, Me., mill of Great Northern Paper Co. This is the first time, according to Great Northern, that a manufacturer in North America has made newsprint from hardwood.

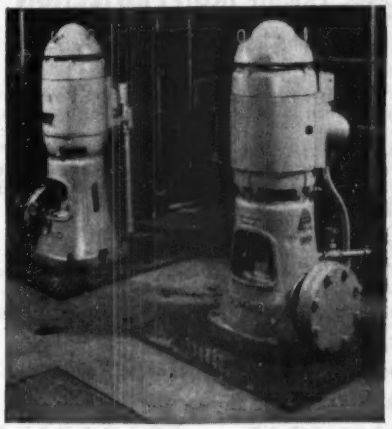
Hardwood has been used to make other grades of pulp and paper, but it has not been used to make newsprint because of its short fiber. Instead, stronger softwood, usually northern spruce, is used.

Great Northern turns out news-



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served by
DEMING PUMPS

Here's another example of the versatility of Deming Vertical Turbine Pumps. Designed originally for deep well pumping, the efficiency and adaptability of these pumps has extended their application to a diversity of liquid handling services.



The two Deming Turbine Pumps illustrated are part of the air conditioning system at the United Nations Building in New York City. Salt river water from the East River flows through conduits to the third basement level and is pumped through rotating drum type screens to free it of foreign matter before use in the air conditioning systems. The Deming Pumps wash the rotating screens to prevent them from clogging.

The installation was made by Kerby Saunders, Inc. Each unit pumps 200 gallons per minute against a 35 foot head. Pumps are powered by 5 H.P. motors.

Deming Vertical Turbine Pumps are available in a full range of capacities up to 3500 G.P.H.



write for bulletin 4700

This illustrated bulletin gives essential facts about Deming Vertical Turbine Pumps.

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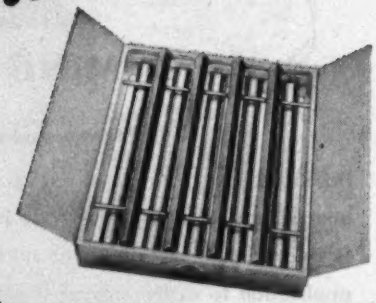
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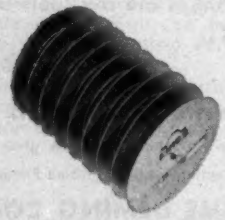
- Cadmium plated, hot rolled steel grill protects the magnets, slows and directs material stream onto all of the powerful magnetic tubes.
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print by a process in which hardwood and softwood pulps are mixed together. The hardwood is pretreated in pressure vessels—probably to soften the wood before it's ground up.

Experimental work on the process has been successfully completed. Great Northern is going ahead with an expansion that will include facilities for the new process.

GE Expands Output of Silicones at Waterford

A sharp increase in the use of silicones in water repellents for masonry is forecast by General Electric as a result of the completion of a $5-million expansion of its silicone chemical plant at Waterford, N. Y.

Now that silicone chemicals will become available in larger quantities, General Electric expects manufacturers to use them for protection of masonry and for other applications where moisture is a problem.

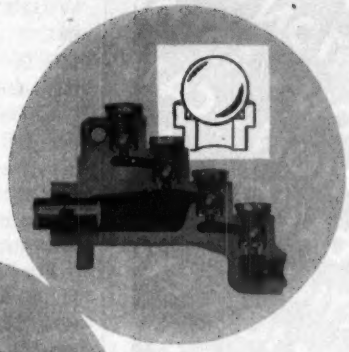
The Waterford expansion will mean an increasing supply of GE's new silicone water repellent. Supplied in a water solution, it becomes water-repellent several hours after application to above-grade masonry. It penetrates deeply into the porous structure of concrete, gypsum, limestone and plaster to retard moisture penetration while still permitting masonry to "breathe."

Development work already in progress by a score of companies indicates further use of the silicone water repellent, known as SC-50, as an additive to improve the washability of water-base paints and to give better brush-out by eliminating bubbling.

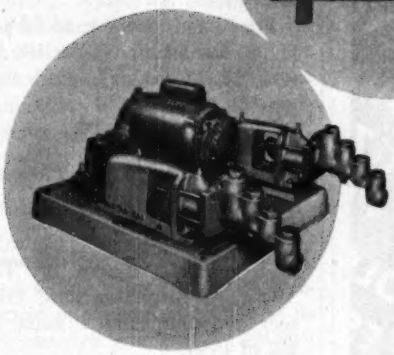
Makers Boost Prices of Soda Ash and Chlorine

Prices of soda ash and chlorine have been increased by producers. Diamond Alkali Co. has increased the price of soda ash 15c. per 100 lb. for carload lots, and the price of chlorine 20c. per 100 lb. in single-unit tank car deliveries, f.o.b. plants. The higher prices will be charged on shipments made on or after May 1. Solvay Process Division of Allied Chemical & Dye Corp. has made similar increases.

Prices of carload soda ash, both light and dense, will be raised 15c. per



Basic design simplicity of the *exclusive* Milton Roy liquid end step-valve assures high and reproducible volumetric efficiency The self-cleaning *double* ball-checks seat positively, dislodge any trapped particles by spinning action, are snap-acting.



Chemical Treatment Costs Drop with this Milton Roy Pump

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On The Job in a well-known chemical processing plant, this Milton Roy Motor-Driven Controlled Volume Pump meters the flow of concentrated sulphuric acid to the deoiling step in an ore flotation process. The accurate control of acid addition results in minimum usage of concentrated sulphuric acid and subsequent caustic, thereby lowering treatment costs.

This is a typical example of how Milton Roy Pumps effect dollar savings in hundreds of applications throughout industry. As motor-driven or air-powered units, or as components of automatic systems, their accuracy and long service life bring measurable returns to users. In *boiler feed water treatment*, for example, they are used in all forms of handling internal or external treating chemicals; in *petroleum processing*, for crude desalting and gasoline treating; in *textile manufacturing*, for acid, alkali or bleach baths; in *instrumentation*, to satisfy control requirements.

These are rugged, dependable pumps. They meter practically any liquid—abrasive slurries, solids in suspension, solvents—in capacities from 3 milliliters per *hour* to 45 gallons per *minute*, against pressures up to 25,000 pounds per square inch with instrument accuracy. We invite your inquiries.



Bulletin No. 553 tells you how you can profitably use Milton Roy Motor-Driven Controlled Volume Pumps in your business. Write for your free copy.

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100 lb. both in bulk and packages, Diamond says.

Chlorine prices are being lifted 20c. per 100 lb. in single-unit tank car deliveries. In multi-unit tank car deliveries the following new price schedules will apply on designated annual quantities:

For 75 tons or more, $3.80 per 100 lb.; 60 to 45 tons, $4 per 100 lb.; 30 tons, $5; 15 tons, $7; and 8 tons, $8 per 100 lb.

New Refinery in Tacoma Will Use Alberta Crude

Pacific Oil & Refining Co. will build a $5-million refinery at Tacoma, Wash. Construction starts this summer, and completion is slated for the fall of 1954.

Capacity will be 10,000 bbl. per day, 60 percent of it gasoline. Alberta oil will be barged from the pipeline terminus at Vancouver, B. C.

This is the second refinery planned for western Washington, General Petroleum having earlier announced its intention of building a much larger refinery at Ferndale, Wash. Shell also may build a plant in Washington.

Nonyl Phenol: A new chemical processing unit at the Port Neches, Tex., plant of Jefferson Chemical Co. will soon go into operation, with nonyl phenol the initial product. Jefferson developed the process for its commercial production, and is now at work on processes for turning out other chemicals related to nonyl phenol. These will also be made at Port Neches.

Perlite: Great Lakes Carbon Co., biggest U. S. producer of perlite, has purchased a perlite mine at Rosita, Colo., and a perlite mill at Florence, Colo., from the Alexander Engineering Division of Alexander Film Corp. Alexander will concentrate on movie and TV film business. Great Lakes gains better distribution, added capacity.

Tall Oil: Newport Industries, Inc., will process tall oil in a new $2.7 million plant being built at Bay Minette, Ala., by Rust Engineering Co. Tall oil, a byproduct of wood pulp manufacture, is used in soaps, lubricants, resins and paints, and

for other industrial purposes. Newport Industries, which extracts chemicals by steam distillation from waste wood and stumps, also supplies materials for wood fiber products.

Plutonium: Prime contract for a $40 million chemical processing plant at Hanford, Wash., has been awarded to Blaw-Knox Co. of Pittsburgh, Pa. General Electric Co. will do the basic design and engineering, while Vitro Corp. of America is architect-engineer. When completed in two years, the plant will add to output of present plants processing plutonium.

Ammonium Nitrate: Commercial Solvents Corp. is just getting into production of ammonium nitrate by its new one-step process in a new unit at its Sterlington, La., plant. The unit was built by Luria Engineering Co.

Butyl rubber: Its first plant will be built by Goodrich-Gulf Chemicals, Inc., at Orange, Tex. It will make butyl rubber under patents held by Esso. —*End*

LITTLE BONER——

40 Man-Hours for 15 Cents

Engineers at a certain chemical plant in New York state decided to develop a water chlorinator. Finally they assembled the unit with all its tubing, fittings, flow meters, valves and what-not. They tested it and it worked like a charm.

Then somebody decided a few changes should be made (somebody always does). Some of the fittings were taken off, then replaced. The unit was tested again—but wouldn't work at all.

"Let's put it together like we had it at first," one engineer suggested. They did. But still it wouldn't work.

Then came three full days of taking apart, putting back together, testing—repeat, then repeat again. It was three days of tedious, tantalizing work peppered with explosions of profanity. Why the hell did it work the first time but not the other sixteen?

Finally one of the fellows noticed a little 15-cent brass tube tee that had been put in the line during the first change.

It had been drilled in one direction only!

"Talk about tremendous trifles," commented the engineer who sent us this little boner, "this takes the prize. Five people wasted three full days—all for the sake of a 15-cent Tee."

Send your own true Little Boner to the Editor, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.

How Can Pangborn Dust Control Save You Money?

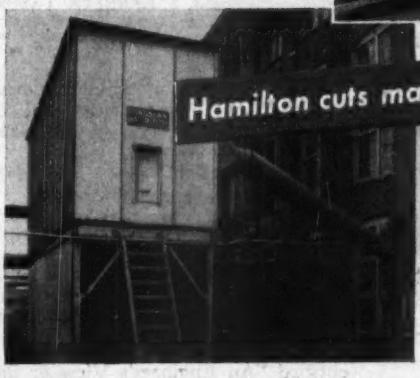
Here's how these firms saved with Pangborn:

Nalco salvages $50 a day



National Aluminate Co., Chicago, Ill., uses seven Pangborn Dust Collectors to trap valuable chemical dusts at the source . . . saves well over $50 a day. Nalco reports that reclamation savings "have already paid for the Pangborn Collectors."

Hamilton cuts maintenance $100 a month



Hamilton Rubber Co., Trenton, N. J., installed Pangborn Dust Control to improve employee morale and reduce plant housekeeping. Pangborn did this and more—savings in maintenance, housekeeping, and machine repairs give Hamilton a bonus of $100 a month!

THE case histories above tell our story. Whether you want to increase profits by reclaiming valuable dust or cutting maintenance costs . . . whether you're interested in improving working conditions or community relations . . . whether your needs are big or small, Pangborn will solve your dust problem. For information on how Pangborn can save you money, mail the coupon below now!

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Pro and Con

Instrument Elements Bulletin?

Sir:

Your Process Instrumentation Report of last May was of great interest and the chart of Process Instrument Elements which supplemented it was invaluable.

I have referred to the chart so much, in fact, that it has now become pretty well worn and I suspect that there may be many more copies around the country in similar condition.

This leads me to the idea that, in reprinting it, you consider the possibility of reproducing it as a small pamphlet or bulletin, rather than as a folded chart. This would make it a most helpful reference for those of us closely concerned with instrumentation. And it might enable you to reproduce type and illustrations somewhat larger.

Incidently, I'd like to call your attention to a transposition of the numbers of Figs. 188 and 189. The Foxboro beam-type force-balance controller is actually Fig. 189, rather than Fig. 188 as indicated.

J. H. Bolton

Manager,
The Foxboro Co., Ltd.,
Montreal 32, Canada

▶ *We're happy to have the correction, as well as the suggestion regarding bulletin form for the Instrument Elements chart. We've had a few other suggestions along the same line. Do you want it? It will cost a little more. If enough of you will indicate interest, we'll do our part and see that you get what you want.*—Ed.

Pro: Paint Advances

Sir:

The greatest advance in paints and varnish in 1952 was the general realization by chemical industrial management of the present high costs of maintenance painting and the fact that if intelligent attention were given to industrial maintenance painting, the performances could be upgraded and maintenance costs reduced.

There was no major development in 1952. In paint and varnish technology, like most other products, any new development goes into the hands of the paint formulator who studies it for a considerable period and confirms his conclusions by exposure tests. This period in which it is in the hands of the formulator, and not available for industrial use, oft-times is over a period of one to three years. Once the paint formulator is convinced of the virtue of the new development, it is then introduced to the users, who in turn require anywhere from one to three years of testing in order to justify adoption of the new development for general use. Therefore the total span from inception to general industrial acceptance of any new development cannot be compressed into any period of a single year.

Kenneth Tator

Kenneth Tator Associates
Coraopolis, Pa.

▶ *Paint authority Tator contributes these additional thoughts to our review of 1952 operations (CE, Mar. 1953, p. 216)*—Ed.

Pro: The Dollar

Sir:

Mr. W. G. Wilcox, who recently retired as Managing Director of our Association and whom I succeeded, has called my attention to the article entitled "An Engineer's View of the Dollar" in your February issue.

The article is most interesting and Mr. Wilcox suggested that I obtain reprints of it, if possible, for members of our Association. Accordingly, if they are available, would you please send me two dozen copies of the reprint.

Frank J. Madden

Managing Director
Salt Producers Association
Chicago 1, Ill.

▶ *This article is part of our popular $1 reprint "Data & Methods of Cost Estimation—Part II."*—Ed.

Con: Nitrophosphates

Sir:

We have been most interested in reading your December editorial (p. 202) called "Two New Ammonia Markets." You announce that Allied Chemical is going to erect a plant at South Point, Ohio, in order to produce 12-12-12 ratio nitrophosphates.

You say that "this apparently is the first substantial development by an oldline chemical company of this new technique. It has long been talked about, but not fully developed elsewhere, except experimentally by TVA and prospectively by one of the farmers co-ops."

We take the liberty of pointing out to you that the kind of process Allied Chemical is going to use is known not only by the TVA, but principally by the effective production of these fertilizers in Europe. Several millions of tons of nitrophosphates have already been produced by various European companies.

In fact, the Societe Potasse et Engrais Chimiques is manufacturing 500 tons a day of nitrophosphates in France. It is this company which has started making the 12-12-12 ratio in 1950—the very ratio Allied Chemical seems to retain.

It seems to use that this additional information might be of interest to your readers, and we should feel obliged if you would publish them in your review.

M. Massenet

Ingenieur en Chef des Mines
Potasse & Engrais Chimiques
Paris, France

▶ *Our reference was to production in USA. Vive la France!*—Ed.

Con: Heating System

Sir:

In your January article "Variable Temperature Heating System," by Joseph I. Lacey (p. 202) I would like to know what advantage is there to using the heat exchanger system over merely admitting the steam direct to the reaction vessel heating surface?

Was this done with the idea that thereby there would never be any effect from the superheat in the 30-psi. steam supply? Was there ever any evidence that such an effect had been obtained?

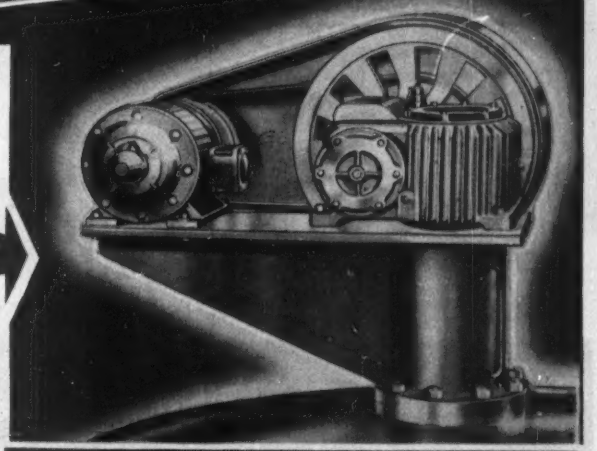
It has been taken as an axiom for quite some time that it is impossible to get a superheating effect through the condensing film on the heat transfer surface of such a vessel, and I should like to know whether or not there has been sufficiently definite evidence, in some other installation, of such a superheating effect, that it

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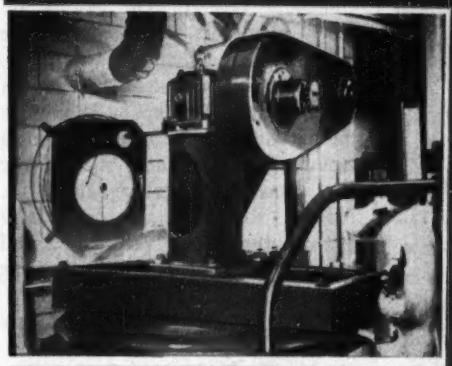
The speed of this unit can be changed while in motion. The capital investment for such a profitable plant improvement is relatively small.

Speed variance as high as 5 to 1 (single speed motor) with any desired speed within the above speed change range. When these units are equipped with vari-speed motor instead of the standard single speed motor an almost infinite range of speeds can be attained in a few seconds.

Speed change accomplished by simply rotating speed change knob. No gears or belts to change.

Useful for viscosity or material change while batch is being mixed. Excellent where various viscosity materials may be mixed in the same vessel.

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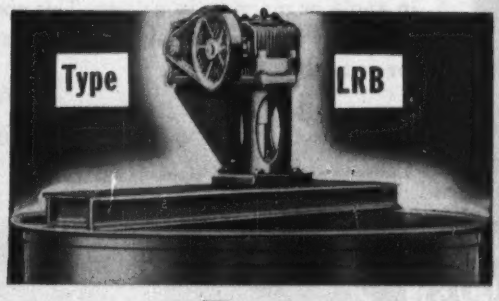
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"International" Type LRB Mixer

(Illustrated Below)

Speed changes by means of sheave substitution with standard stock taper hubs and adjustment of belt tension requires only a few minutes of operator's time.

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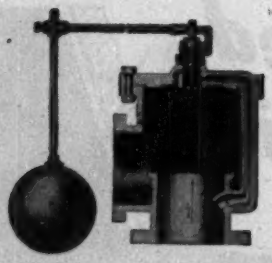


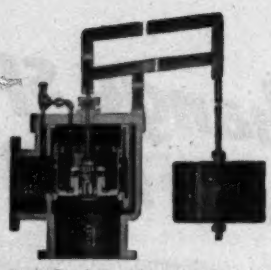
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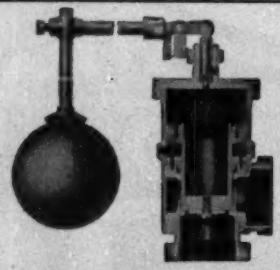
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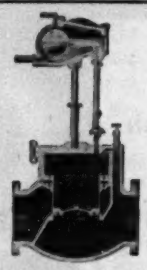
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was decided that the heat exchanger expense was justified. Otherwise the same kind of operation could have been secured by merely piping the live steam directly to the vessel jacket.

J. B. McMahon
Republic Flow Meters Co.
Chicago 47, Ill.

► *Author Lacey answers below.*—Ed.

Pro: Heating System

Sir:

I agree with Mr. McMahon's comments on the lack of effect of superheated steam in heat transfer work. I have never seen any evidence that points to the existence of such a phenomenon. In this case, however, the objects were, to provide a temperature range in the jacket from 80 to 100 deg. C., to maintain a reasonably fast, but not excessive distillation rate, and to keep the temperature of the film inside of the vessel at a minimum.

If steam at a slight pressure were fed in at a controlled rate, it would condense over only a part of the area to give local hot spots. The next thought might have been a vacuum-steam system, but this sounded "messy." Syphons, etc., mean another piece of equipment to be watched and maintained.

From this, the system described in the article was developed. It also has the advantage of changing from a vacuum to a pressure system if the heat demand so requires. The 30-lb. reduced steam pressure acts as a "temperature safety valve" and will prevent the temperature from going above 30-lb. saturation temperature.

Joseph Lacey
Chemical Engineer
Hooker Electrochemical Co.
Niagara Falls, N. Y.

Westvaco in the West

Sir:

I read with interest your editorial comment on William T. Nichols in the December 1952 issue. I am happy to say that from my own personal knowledge, the statements made about Mr. Nichols' connection with the two Westvaco projects (the first commercial elemental phosphorus plant based on Idaho phosphates and the first commercial soda ash operation based on Wyoming trona mines) are correct.

I presented these projects to West-

vaco in 1944 when Mr. Nichols was still connected with that company, and he was very helpful indeed.

In the September 1941 issue of *Chem. & Met.* you published an article entitled "Possibilities for a Wyoming Chemical Industry" in which you gave me full credit for my part in this work. This was the project which I presented several years later to Mr. Nichols, as representative of Westvaco. It included the proposal for producing phosphorus by the electric furnace method rather than by making phospohric acid by the wet method.

No doubt the Pocatello phosphorus project and the Green River soda ash project will come in for considerable attention in the chemical engineering world in the years ahead. For this reason, I have taken the liberty of presenting to you the above outline of the historical background.

ROBERT D. PIKE

Consulting Engineer
Stamford, Conn.

▶ *At a recent meeting at the new $20,000,000 trona plant in Wyoming, Westvaco's Max Seaton introduced Consultant Pike as the "father" and Senator O'Mahoney as the "grand-uncle" of the mammoth development.*

To this we add the credit due Westvaco's management (including Vice President Seaton himself) for their vision and courage in commercializing the Idaho phosphorus and the Wyoming trona projects. Both are pioneering efforts of major import.—ED.

Con: Vertical Furnace

Sir:

Page 247 of December *Chemical Engineering* says 30-ft. fall and time of fall 0.015 sec.

There's a wasp in the beehive? According to my old physics book

$$S = \tfrac{1}{2}g^3$$
$$= 16 \times 0.00225$$
$$= 0.036 \text{ ft.}$$

in vacuo!

JAMES T. MACKENZIE

American Cast Iron Pipe Co.
Birmingham, Ala.

▶ *Let Reader Mackenzie return to his physics book and find*

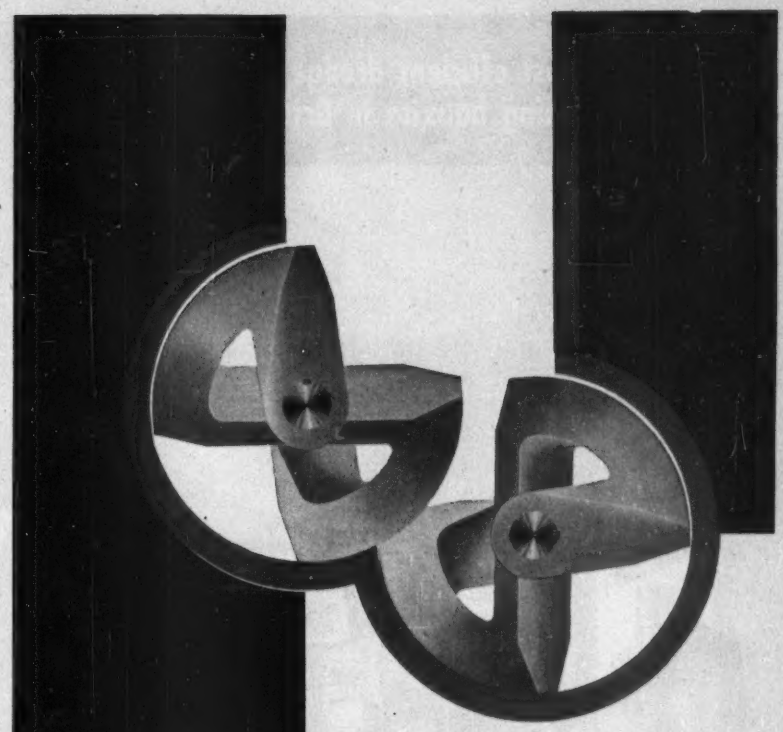
$$S = V_0 t + \tfrac{1}{2}gt^2$$

and also see the comment below.—ED.

Pro: Vertical Furnace

Sir:

I think Dr. Mackenzie has overlooked the fact that the time of fall is controlled by the velocity at which



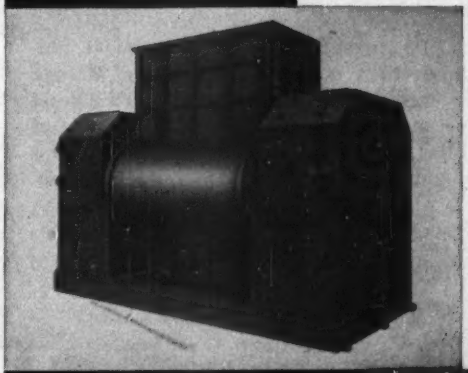
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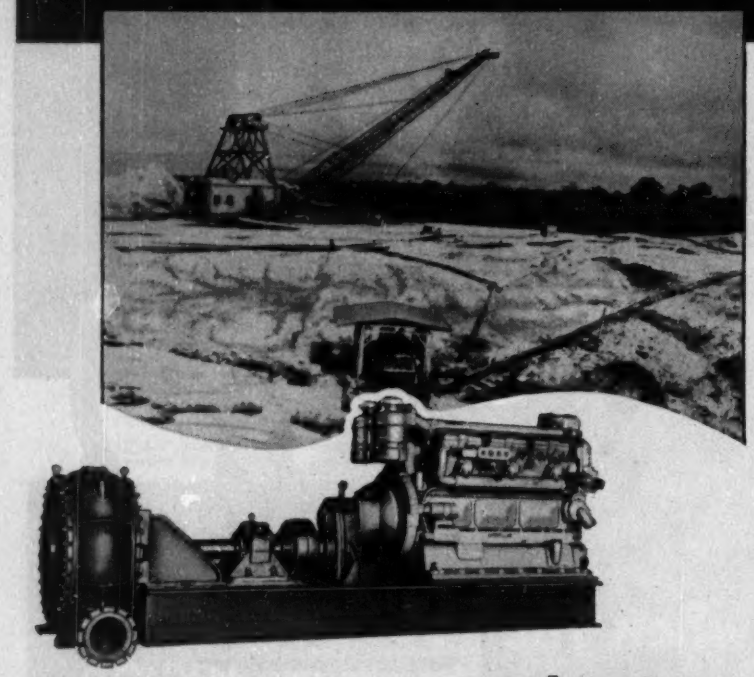
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Pro & Con, cont. . .

the clay particles issue from the burner and by the pressure within the furnace.

In connection with that same article we have had a number of disturbing comments from readers who interpreted the statement in the last paragraph to refer to production costs rather than to estimated selling prices, which was the intention. You well know that in a new process there may be very little relation between production costs and the retail price at which a new product is first introduced to the market.

J. D. McLaughlin
President
Kanium Corp.
Chicago 4, Ill.

► *(1) True, (2) true.*—Ed.

Pro: Mathieson

Sir:

Your March issue (p. 186) has erroneous figures for Mathieson Chemical Co.'s profits. We know these mistakes can happen anywhere but it is particularly unfortunate when a comparison is made with other companies.

The correct figures for the first nine months of 1951 and 1952 before and after provision for taxes are as follows (as thousands of dollars):

1951	
Before	*After*
$18,247.0	$7,757.0
1952	
Before	*After*
$16,434.7	$8,879.7

It would be greatly appreciated if a correction could be printed in the next issue of the publication.

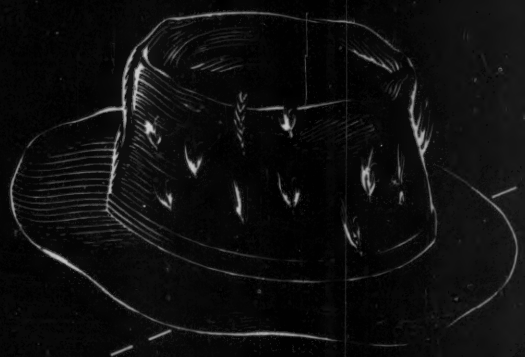
Robert Nathans
President
Opinion Builders Inc.
New York 17, N. Y.

► *Published figures were 3-mo. instead of 9-mo. profits.*—Ed.

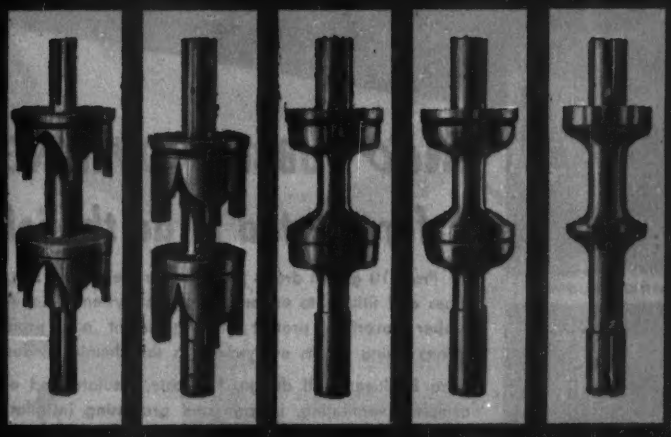
Con: Soda Ash

Sir:

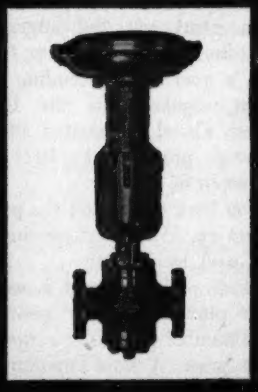
In your table of soda ash consumption (*CE*, March 1953, p. 193), I might suggest that the heading "Other Chemicals" be broken down into some sort of generalized categories so as to make the compilation a little more useful to the average reader. In the last twenty years this heading has gotten awfully large and overshadows most of the others. In its present state



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it has little more significance than the heading "Miscellaneous."

Z. G. Deutsch
Consulting Engineer
Grand Central Terminal Bldg.
New York 17, New York

▶ *Alkali Expert Zola Deutsch is right. Watch for next year's tabulation.*—Ed.

Con: Intermountain Report

Sir:

Your article "Raw Materials Aren't Enough" in the October issue is being quoted widely in this area. It is an excellent article. However, like all such articles, presenting the complete picture is rather difficult.

In general, the article tends to oversimplify the reasons for the seemingly slow development of the Intermountain Region. Most of the emphasis rests on freight charges, power rates and the availability of cheap natural gas. These are significant items in the cost patterns associated with the production of many commodities. Improvement of the over-all picture will result when any of these factors is reduced. However, the failure of any concern or the non-development of any resource should not properly be attributed to any of these factors singly. Rather, it is a combination of these factors in conjunction with many others that result in such action. . . .

Specifically, in stating (p. 356) that "when German Potash reappeared the Utah operation proved uneconomical," you should have added that at the end of World War I there were 128 potash producers in the U.S. (This Utah plant was the largest single domestic producer). After the War . . . a gradually descending scale of prices, regulated by the European Potash Cartel, eliminated all but 12 domestic producers by 1922 and all but seven by 1926. . . .

You have misquoted the power situation (p. 358). Perhaps the average rate paid by industry . . . is 1.5 c. per kwh. . . . Kennecott, however, has been purchasing their power for a good number of years at a considerably lower price. A more important reason for Kennecott's building their own power unit was their expectations (now realized) of electrolytic copper refining. Few concerns in the region consume power in quantities such as the electrochemical industry requires. Amount of power consumed is an im-

portant factor in rate-making. Average power costs are not a good indication of rates experienced by any single firm or group of firms. Nor can Monsanto afford to pay 6 mills for power for their phosphorus operation as stated on p. 360 (4 to 5 mills is a more realistic figure). It is unlikely that we shall have electric energy at "give-away" prices in this area. . . .

There is considerable natural gas in the region (p. 360), but it is questionable that it could be supplied economically to any large consuming center. As long as there is a shortage of gas for residential use . . . it is improbable that there will be an uninterrupted supply of industrial gas available from present sources. . . .

Expanded petroleum producing and refining capacity in the area may be the forerunner of an organic chemical industry (p. 361), but it is not the only basis for expansion in all chemical phases—elemental phosphorus *per se*. . . . The high wax content in some Utah crudes does pose technical problems, particularly in transportation. However . . . oil is known to vary from field to field—and from sand to sand in the same area as well as to some extent in the same deposit. . . . Thus, it is extremely doubtful if the other wells being drilled in Utah are done so "in the face of enormous transportation costs and technical problems posed by the high wax content" of a crude already being produced.

Idaho produced 694,446 long tons of phosphate rock during 1951. That 1951 production of the four-state western phosphate field totaled 1,178,000 long tons. Though Simplot is the largest single miner of western phosphate rock, his production did not approach 800,000 tons reported in the article (p. 364). . . .

ELROY NELSON

Director
Economic and Business Research
University of Utah
Salt Lake City, Utah

▶ *Reader Nelson's general criticism presents a true picture. Author-Editor Schrier, however, did not intend to suggest that the seemingly slow development of the Intermountain area is attributable to any one of the factors mentioned.*—ED.

Con: Manpower Commission

Sir:

With interest and in a spirit of outrage I note a news item to the effect that the Engineering Manpower Commission of the Engineers' Joint Coun-



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cil has turned to propaganda in order to secure more engineers for industry. After twenty years of New Dealism, it is to be expected that the erroneous and evil idea should spread that the printing press and the loudspeaker can negate the law of supply and demand.

A shortage of 40,000 engineers, indeed! As long as competent engineers are unemployed simply because they are over forty years of age, no shortage of engineers exists. The only scarcity is recent graduates who would be willing to work for $130 per month.

Now that the employers are going evangelizing in the high schools, I wonder if the students are going to be told the truth—the whole truth? For instance, will they be told that:

1. As late as the summer of 1950, while employers were scrambling for the recent engineering graduates, thousands of capable engineers were out of work simply because of their age?

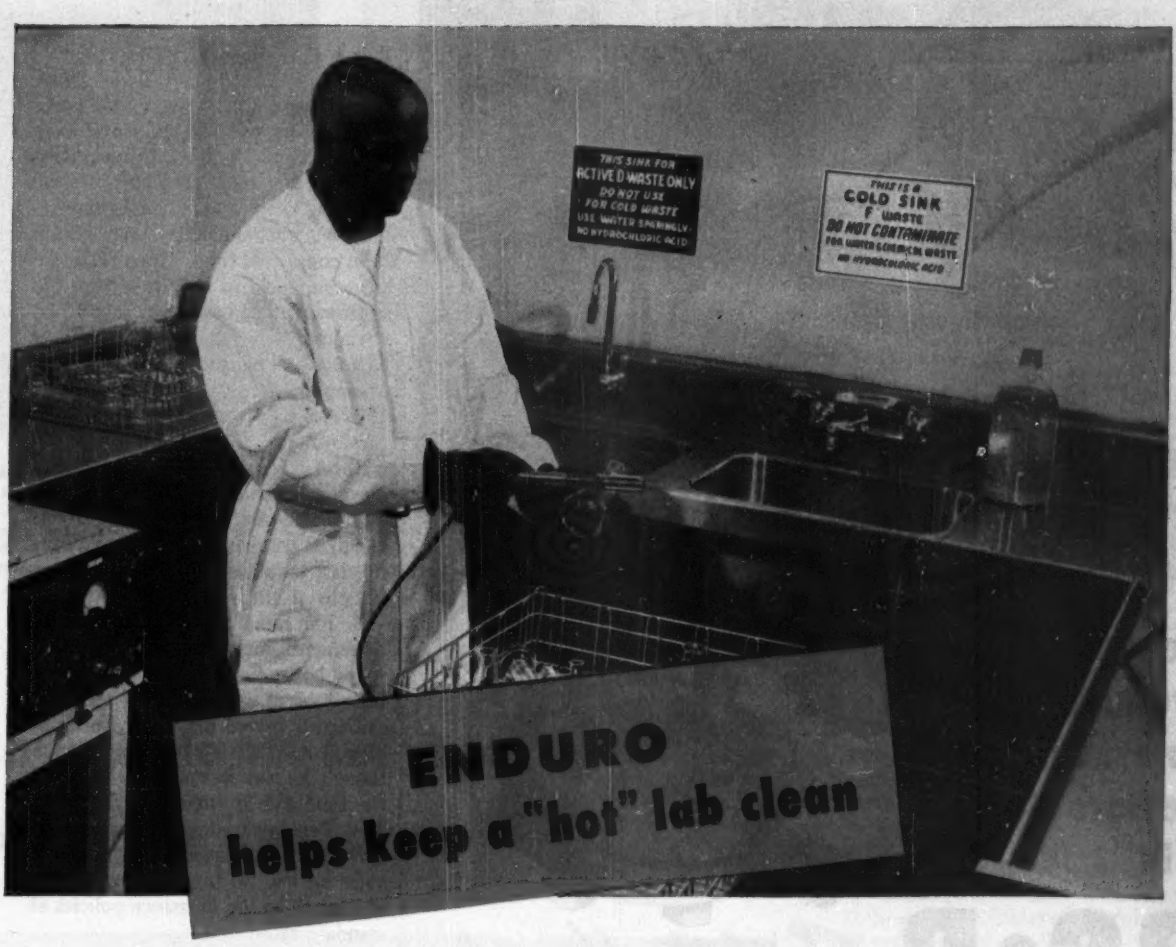
2. The salary for the older engineer is low, not only when compared with other employment, but even with young engineers. In a typical case, with only a few years' experience an engineer can make $500 per month, but the engineer who graduated in 1939 makes only $625, and the engineer who graduated in 1930 makes only $700 per month?

3. Certain employers were as happy to observe the wage stabilization law of the last administration as they were to observe the minimum wage law in the Thirties, when experienced engineers were paid $20 weekly.

4. Hundreds of government research contracts are carried out by technical schools which can underbid private engineering firms, since the schools, in part supported by the public, have a big supply of students who are virtually forced to work for sub-standard wages?

5. When economy is the watchword, employers frequently lay-off engineers several hundred at one time in a single organization. I must admit that they rehire them after several months, but naturally not always the same men, and, of course, at lower wages? (Can an engineer be considered to be on salary, when with many firms the engineer waives all right to any dismissal pay at the time he signs the employment application blank?)

6. With frequent lay-offs, all present pension plans for engineers are



Everything in this atomic lab at Brookhaven, L. I., has to be spotless...or it's dangerous. It has to be so clean that a Geiger counter barely ticks. That means it has to be washed and scrubbed. Intensively. There can be no radioactive elements on equipment to disintegrate.

It also means that all equipment must have a finish that washes easily . . . cleans thoroughly. There's no question about the glassware. Or about those Republic ENDURO Stainless Steel sinks, either. Their finish is glassy-smooth, the big reason why a simple warm rinse and a wipe usually restore their lustre. Even scrubbing with standard cleaning compounds won't mar ENDURO's finish. It's the same—all the way through.

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ENDURO's *cleanability* is only one of its many advantages. It resists high temperatures. It resists corrosion. It is chemically inert. And it has been proven in more than 10,000 different applications. A Republic metallurgist will be glad to put ENDURO's qualities to work for you. Just write to:

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It has taken years of research to know exactly what metals do each job best—for the pressures involved, for the liquids or gases involved depending on their corrosive or bland nature.

All this research has made BS&B Safety Heads and their rupture discs the world's accepted standard for secondary (and often primary) protection against pressures. That's why they're code-accepted—and guaranteed.

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practically worthless, save for the lucky few who are not laid-off before they reach retirement age. Unions have pensions for their members despite that craftsmen change employers frequently, but engineers have always been considered to be expendable like office supplies, so he doesn't deserve a permanent pension plan that could be administered by trust companies on a national basis regardless of change of employer?

7. An engineer can be kept from employment by malicious and untruthful references from his last employer because of the practice of personnel managers in some of the largest chemical companies, who phone only the last employer and drop all negotiations if the report is unfavorable.

8. For some firms the medical requirements for employment have no sound basis. For example, the medical history of an operation over ten years earlier has barred the writer from employment from several firms, even though he was in excellent health at the time and fit enough to do mountain climbing; moreover, his life expectancy was as good as anyone else, since he had no trouble in obtaining at least three life insurance policies at standard rates!

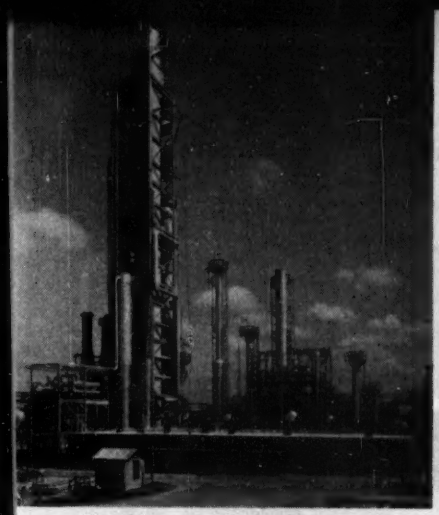
9. The talents of thousands of engineers are wasted. In many offices, for example, the "office engineer" performs routine clerical work which could be done by any clerk.

Now I do not object to employers paying $20 per week to engineers, but I despise the employer who is ignorant of the basic laws of economics. He starves the engineer in normal times and now he literally screams in panic because the supply of $130 per month engineer no longer exists! It is a self-evident truth, in this world every evil contains the seed for its own destruction. If engineers are not appreciated by society, ergo, the supply of engineers falls off until the supply matches the demand. Nothing could be simpler—or fairer—than that! Thus, words will not create engineers. Only a demand for engineers will engender the supply.

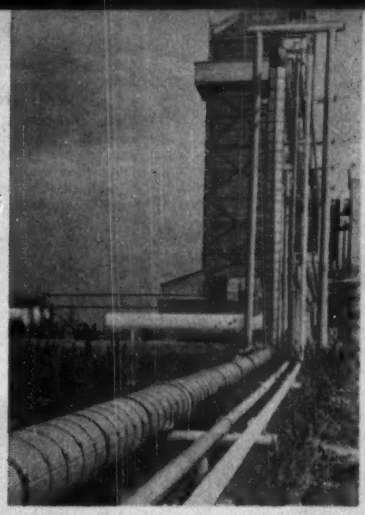
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▶ *This bitter comment criticizes all employers. We wonder if the good ones can do anything about the bad ones.*—ED.

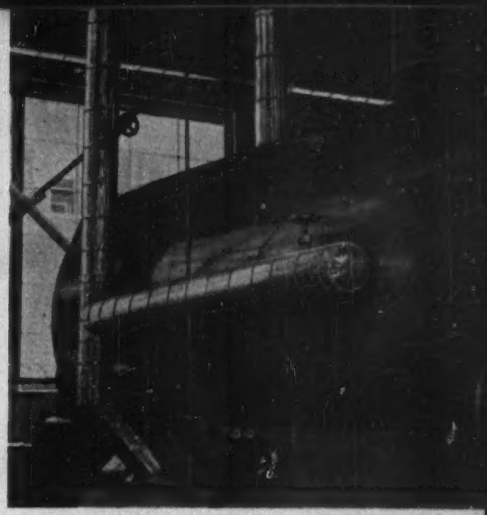
—End



This big new Oklahoma refinery has used a new kind of aluminum jacketing throughout on both insulated lines and towers and vessels. Light in weight and low in cost, this new Childers Aluminum Jacketing cut installation costs. It is also expected to cut maintenance costs.



Childers Aluminum Jacketing is used here on a cross-country transfer line at a large chemical manufacturing plant in Texas. This is a rugged test for any jacketing, but the light-weight aluminum used in this jacketing should stand up to weather and chemical corrosion it encounters.

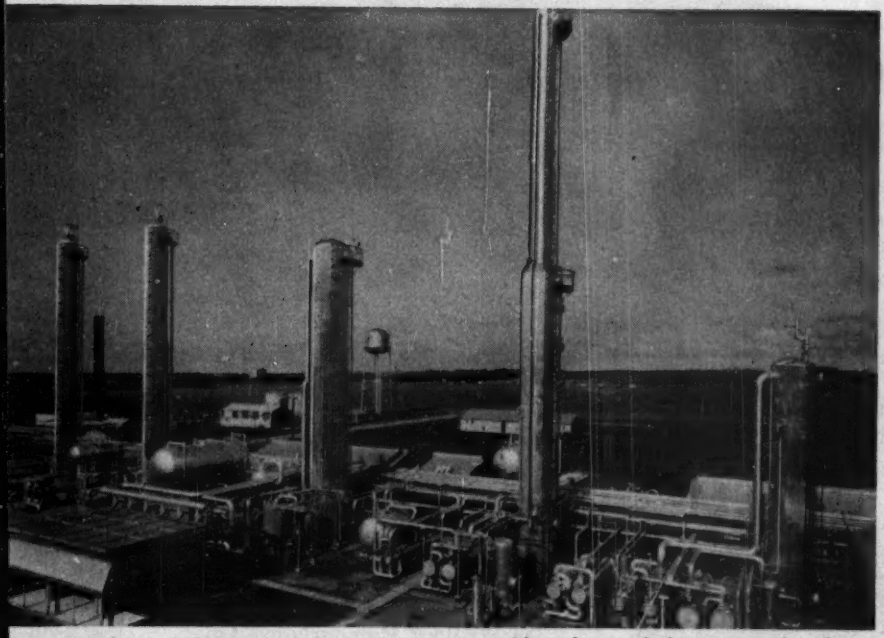


"Good Housekeeping" is the word in this gas pipeline pump station. The insulated lines are handsomely protected by Childers Aluminum Jacketing, which should last as long as the plant itself. The jacketing requires no painting and very little other maintenance. It even allows the interior of the plant to be washed with a hose without harm to the insulation. The chief engineer reports: "We have standardized on Childers Jacketing for all our insulated lines. It is doing an excellent job for us and saving us money."

How 5 plants cut costs of jacketing insulated lines

Weather-resistant, low-cost, easy to put on—these are big reasons for the growing popularity of a new jacketing, specially engineered for insulated lines. It is made of .006" thick aluminum and comes with or without a moisture barrier. It is called Childers Aluminum Weatherproof Jacketing. You can write for a free sample without obligation.

Address Childers Manufacturing Co., Dept. CE-4, 3620 W. 11th St., Houston 8, Texas.



Weather, wind and corrosive gases are not going to attack the insulation of this new plains-country gasoline plant. The insulation is protected by long-lasting aluminum: Childers Aluminum Weatherproof Jacketing. The management expects this low-cost jacketing to hold insulation maintenance costs to a minimum. Other advantages are that the jacketing went on quick and easy during construction; it required no special tools or skill—no shop forming or cutting. It can be taken off and re-used if lines are moved. Aluminum saves on painting and the tough 3S alloy used for Childers Jacketing should stand up for years even in highly corrosive industrial atmospheres. Check the advantages of this jacketing for your own plant.



Amazingly easy to handle, Childers Jacketing was applied here by men using no more than a wooden wedge and a pair of pliers. Childers has engineering representatives in every major industrial center who will be glad to confer with you on your particular jacketing problems. Write to address shown above.

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Heat Exchangers of

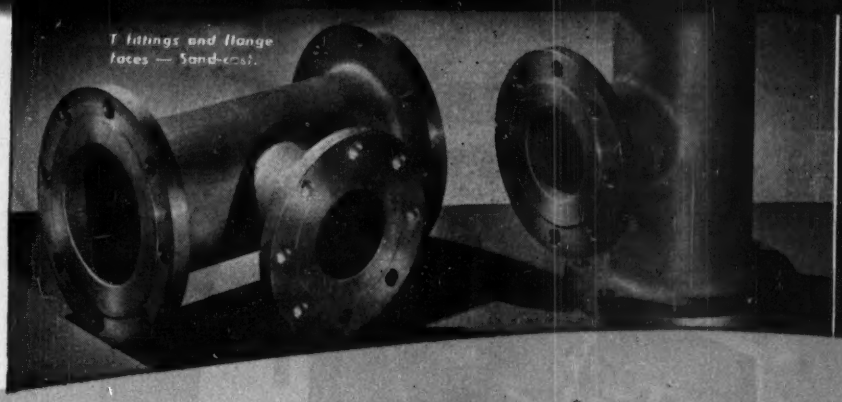


Downington Iron Works, Inc.

These two exchangers, fabricated by Downington Iron Works, Inc., Downington, Pa., are used in condensing benzene. Ampco Metal Tube sheets are welded to a steel shell and the heads, also made from Ampco Metal, are welded to steel flanges. All welding is done with Ampco-Trode® electrodes. Shell diameter 14". Tube length 10 feet.

The Whitlock Manufacturing Co.

This 4-pass exchanger was fabricated by The Whitlock Manufacturing Co., Hartford, Connecticut. The service is product cooling, with river water as the cooling medium. Channel cover — steel, lined with Ampco Metal Grade 8. Channel, including flanges — Ampco Metal Grade 8. Tubes — 1323 sq. ft. — ¾" OD x 16 BWG x 16'-0" Ampco Metal Grade 8. Physical construction — Whitlock Type 4-ST-4 straight tube floating head (split-ring assembly design). Shell diameter — 27 inches ID.



T fittings and flange faces — Sand-cast.



Valve bodies — Sand-cast.

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resist corrosion and erosion

YOU can get better service from your heat exchangers, when you use Ampco Metal for those parts that are subjected to attack by corrosion or erosion.

But heat exchangers are not the only application for Ampco Metal. You find it used in many places in the process industries and in marine service as well . . . for tanks, pipe, separators, bubble caps, fractionating towers, stills, condenser water boxes, agitators, etc. — wherever you need high resistance to corrosion and erosion.

Ampco Metal Grade 8, one of the Ampco series of engineered aluminum bronze alloys, is Boiler Code approved for unfired pressure vessels. In addition, you get these unique properties: high resistance to corrosion . . . high tensile (75,000 psi) . . . high physicals at extreme temperatures . . . high strength to weight ratio . . . high impact and fatigue values (Charpy @-423° F., 93 ft. lbs.; @ 70° F., 75 ft. lbs.; fatigue limit 28,000 lbs. @ 100,000,000 cycles) . . . high resistance to wear from erosion, abrasion, cavitation pitting . . . high compressive strength (E. L. in Comp. 25,000 psi) . . . high modulus of elasticity (18,000,000).

Moreover, Ampco Metal Grade 8 is easy to fabricate with Ampco-Trode* welding wire, rods, or covered electrodes. And, Ampco Metal Grade 8 is available in a variety of forms — sheet, plate, extrusions, pipe, tubes, fasteners, etc. Since it is the answer to many problems, it may help you. Consult your nearest Ampco Field Engineer or write us for further information.



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Send me information on the application of Ampco Aluminum Bronzes for corrosion-resistant service in the Process Industries

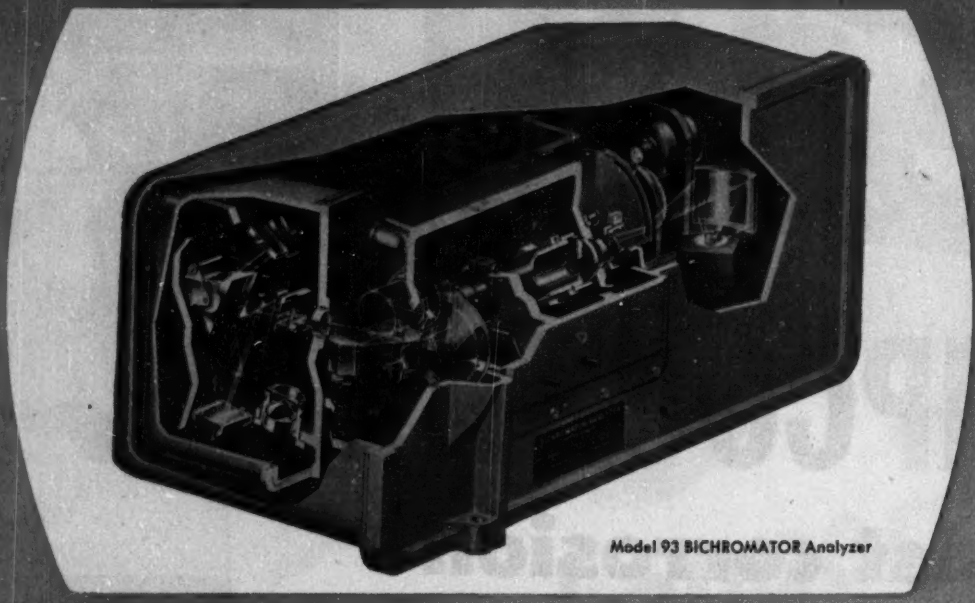
Name..... Title.....

Company.....

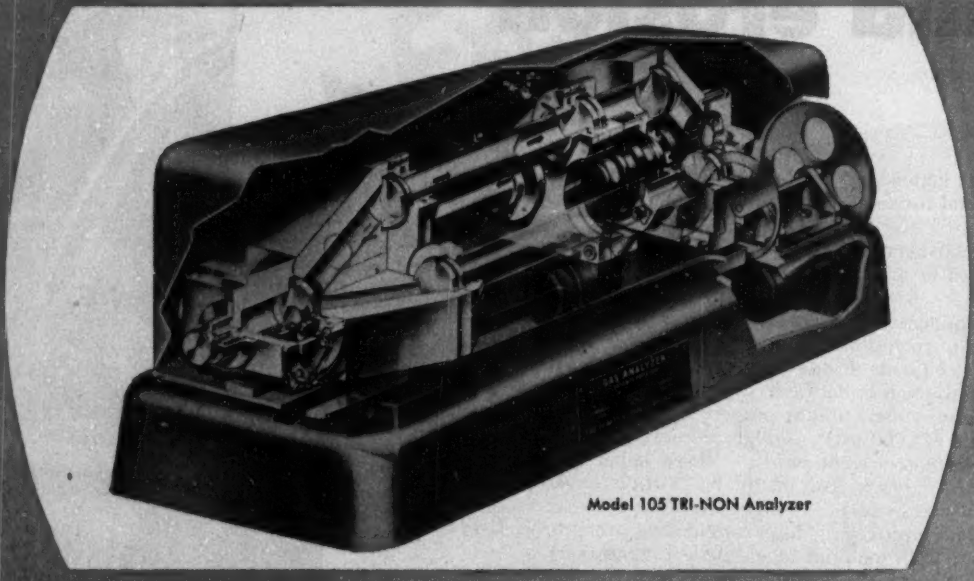
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Model 93 BICHROMATOR Analyzer



Model 105 TRI-NON Analyzer

FEATURES:

Model 93 BICHROMATOR Analyzer

- A dispersion instrument
- Operates on optical null principle
- Records the ratio of absorption at any two predetermined wavelengths
- Unaffected by changes in source temperature or sample cell transmission
- Accommodates sample cells up to 22 cm
- May be applied to liquid or gas streams
- Automatic circuit testing and unitized construction simplify field servicing.

Model 105 TRI-NON Analyzer

- A selective non-dispersion instrument
- Operates on true radiation null principle
- Analyses for one component in a multi-component stream
- 40 cm total path length
- Highly stable, sensitive
- Best suited where there is component interference
- Automatic circuit testing and unitized construction simplify field servicing.

PERKIN ELMER

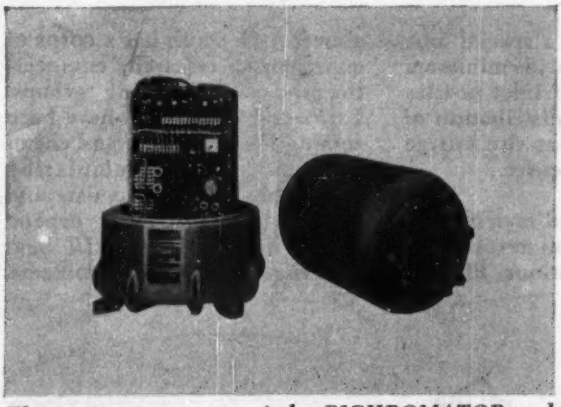
Leading Manufacturer of Infrared Analytical Equipment

PERKIN-ELMER ANNOUNCES TWO NEW CONTINUOUS PLANT STREAM ANALYZERS

The BICHROMATOR* and TRI-NON* Analyzers—with complete process application and installation services—make continuous stream analysis a practical reality

*Trademark of The Perkin-Elmer Corporation

Continuous analysis of a process stream leads to greatly improved operating efficiency—often permitting conversion from batch to continuous processing. The new Perkin-Elmer analyzers fit directly "on the line" and record continuously the concentration of one component independently of variations in the other components. They may be used to control process variables such as temperature, pressure, flow rate, etc., to insure uniformity of product.



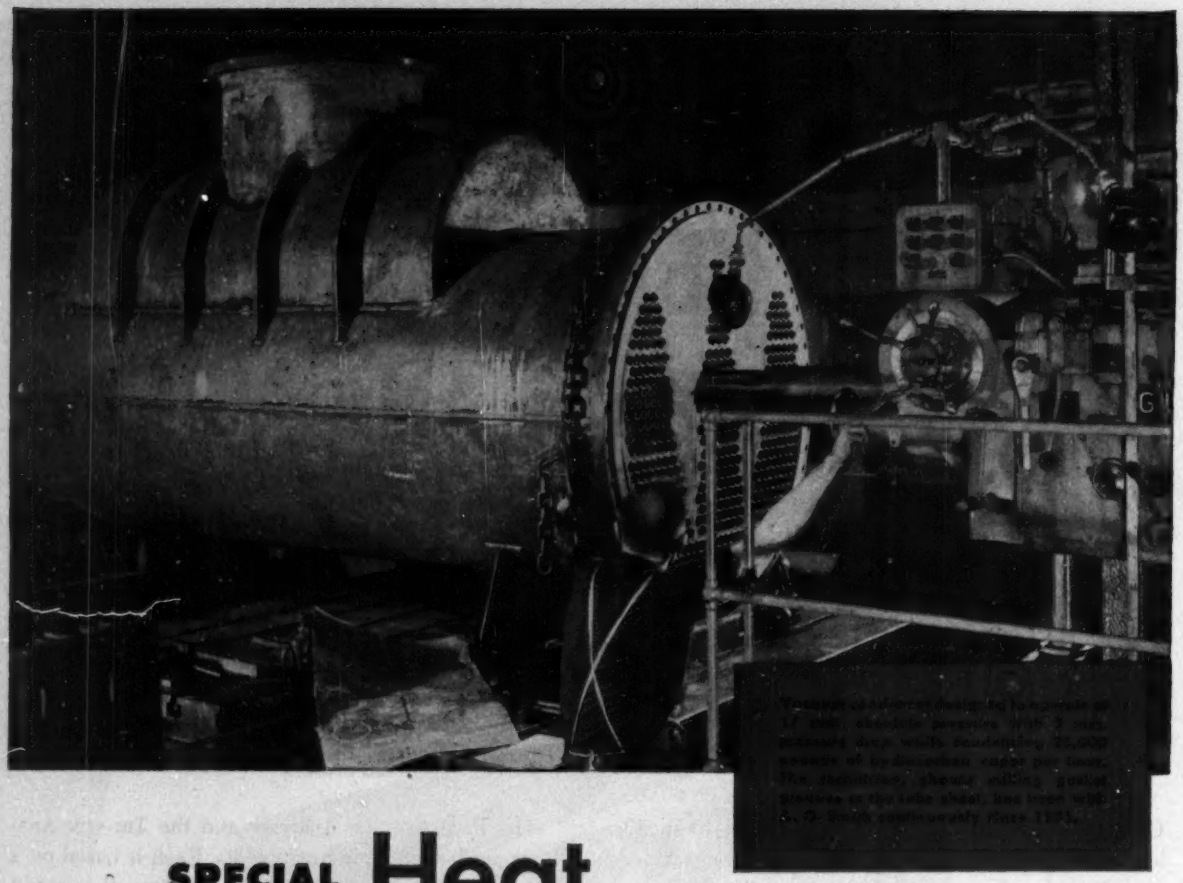
Electronic components of the BICHROMATOR and TRI-NON Analyzers, and the optical units, are mounted in explosion-proof containers.

The BICHROMATOR Analyzer and the TRI-NON Analyzer are both unique instruments. Each is based on a different optical principle. Between them the widest possible range of analytical problems can be solved. The analyzers were specifically developed by engineers with wide experience in process instrument design to meet the difficult operating conditions normally found in the processing plant. The instruments are insensitive to vibration, unaffected by extreme temperature conditions; meet safety requirements and, through unitized construction, are easily serviced in the field.

Applications for continuous infrared analysis are numerous in nearly every chemical processing plant. A staff of chemical processing and instrumentation engineers await your process control problems. They are equipped to provide a complete problem solution and deliver calibrated and adjusted instruments for specific streams. Sample handling and installation services are also available.

Write for complete information on the BICHROMATOR and TRI-NON Analyzers and Perkin-Elmer's process evaluating facilities. Inquiries describing specific problems are invited.

THE PERKIN-ELMER CORPORATION
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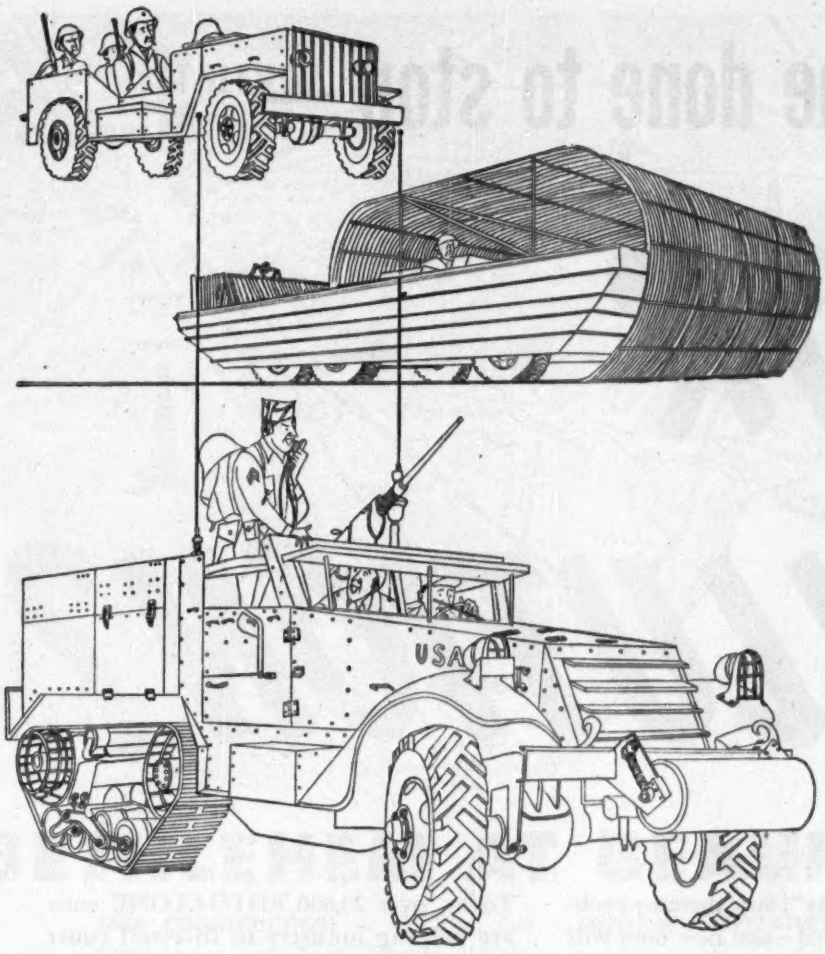
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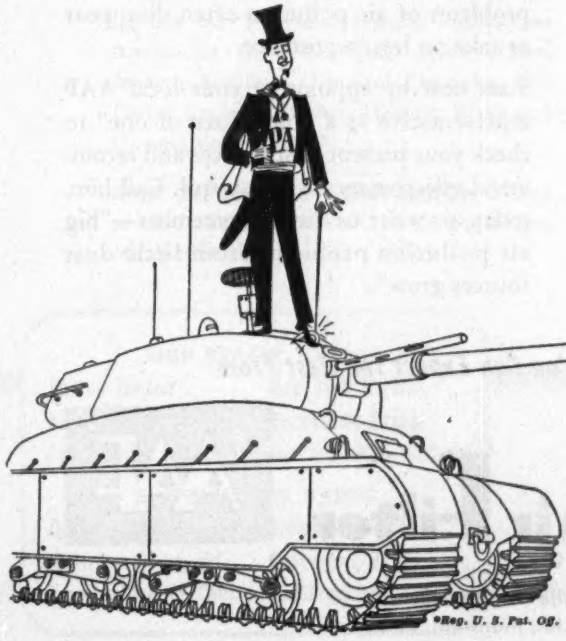
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WITH HEAT EXCHANGER PROBLEMS



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Today, over 20,000 ROTO-CLONE units are helping industry to forestall court injunctions, citizens committees and irate housewives by removing that major irritant —dust. With dust under control, the other problems of air pollution often disappear or take on less importance.

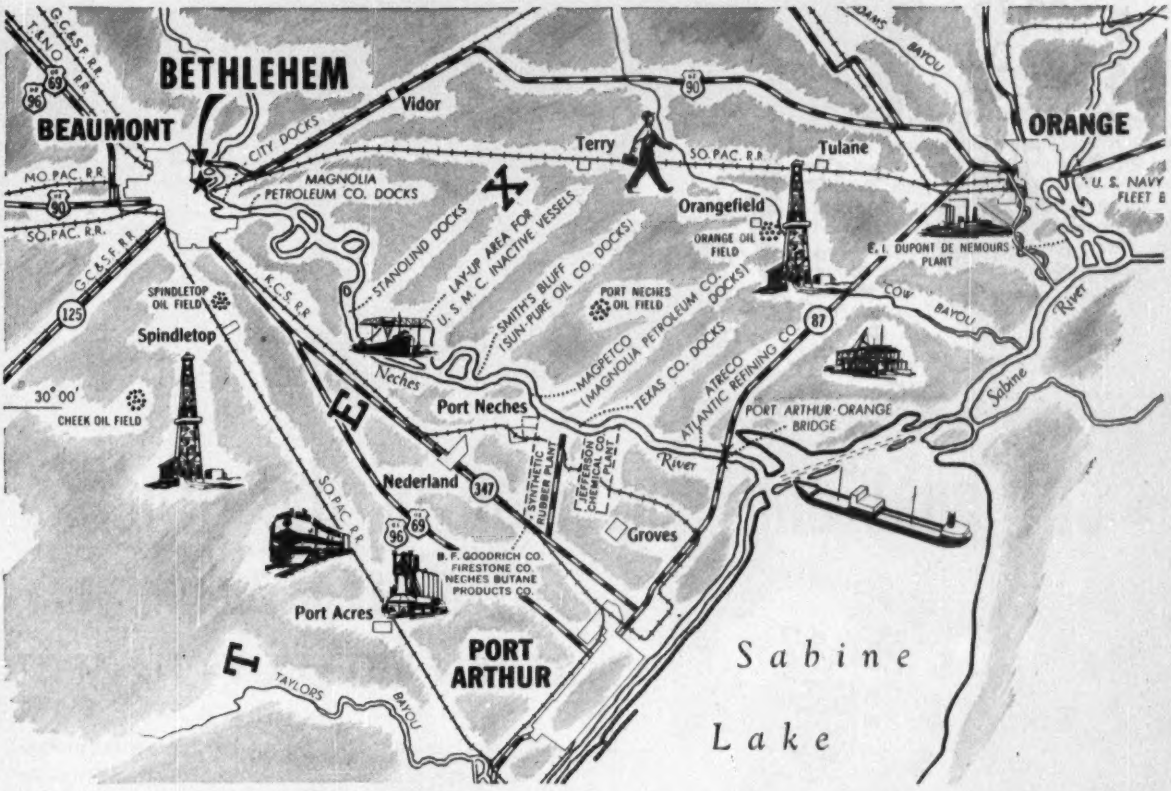
Start now by appointing your local AAF representative as a "committee of one" to check your present dust sources and recommend effective means of control. Call him, today, or write us direct. Remember—"big air pollution problems from little dust sources grow".

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Cut cost and corrosion in the process

WITH ALCOA ALUMINUM FOR PROCESS EQUIPMENT

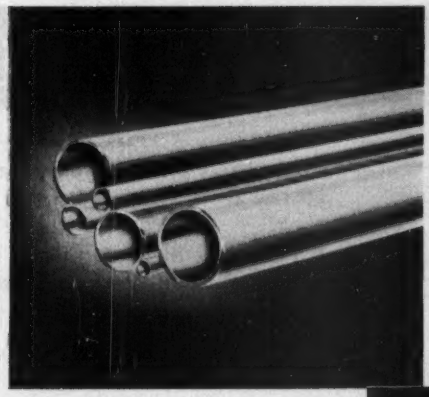
Alcoa Aluminum offers many advantages to the process industries—generally at lower original cost than other corrosion-resistant metals. For example, Alcoa Aluminum offers:

EXCELLENT LOW-TEMPERATURE PROPERTIES. Aluminum actually increases in strength and ductility as temperatures drop to −320° F and below. Alloy 3S-H14, for example, improves 67 per cent in tensile strength, 23 per cent in yield strength and more than 80 per cent in elongation.

LOW COST. Aluminum continues to have a significant price advantage over most other metals. For example, Alcoa Heat Exchanger Tubes cost 1/3 less than mild steel, 1/2 less than Admiralty, 1/5 as much as stainless.

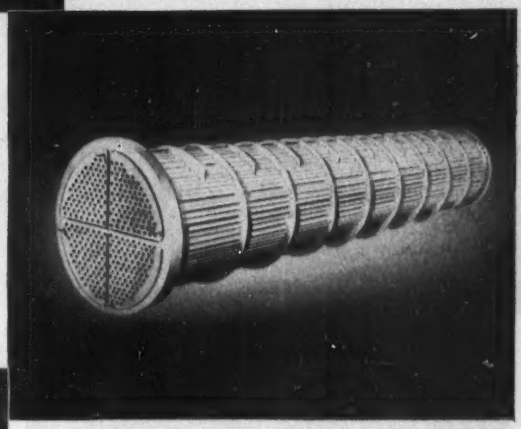
HIGH RESISTANCE TO CORROSION. Aluminum effectively withstands the corrosive effects of hydrogen sulphide and other sulphur compounds, most waters, carbon dioxide and many other organic and inorganic chemicals, food, drug and petroleum products.

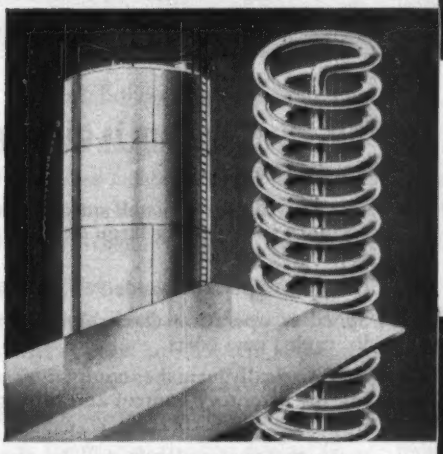
GOOD WORKABILITY. Aluminum is easy to form, shape, machine and assemble with standard equipment. It can be joined by all the common methods of welding. Certain alloys can be brazed.



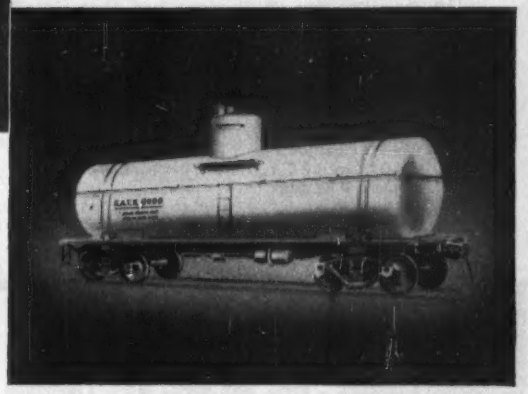
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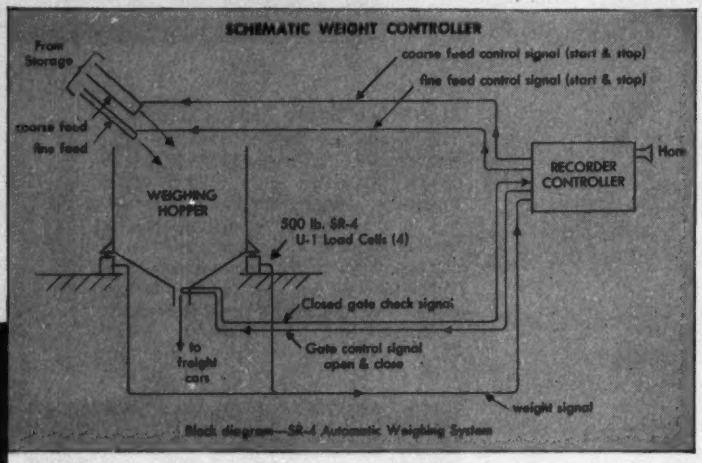
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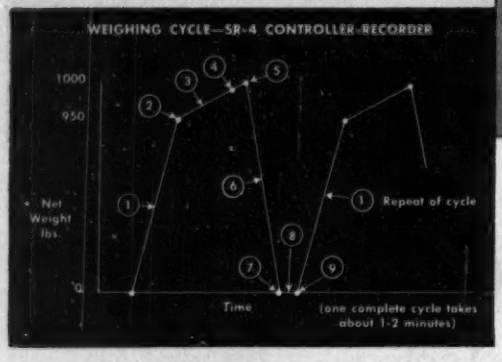
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4. Fine feed automatically shuts off at 998 lb. (adjustable) . . . to allow for amount of material between feeder and weigh hopper.
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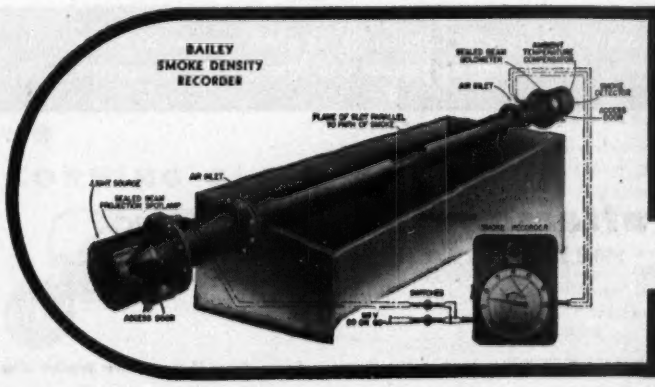
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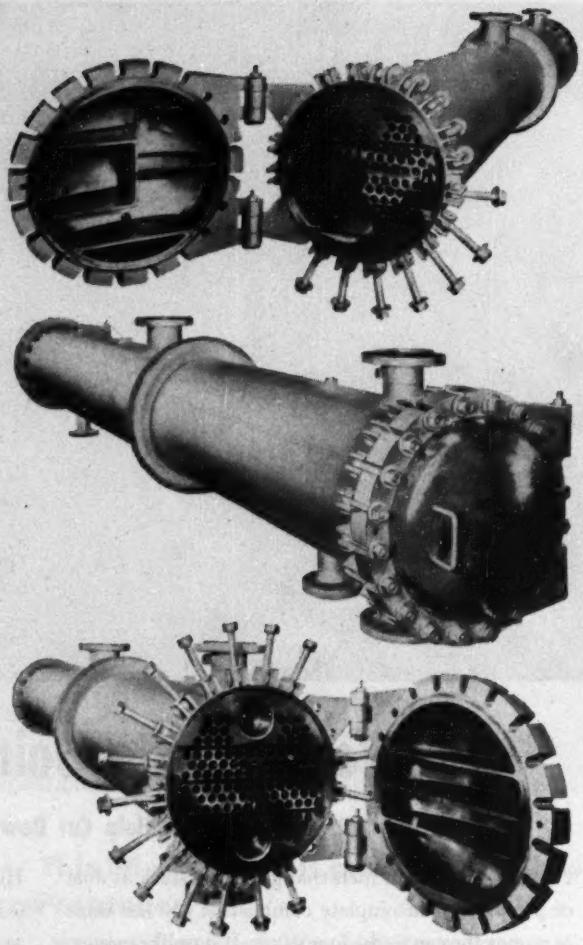
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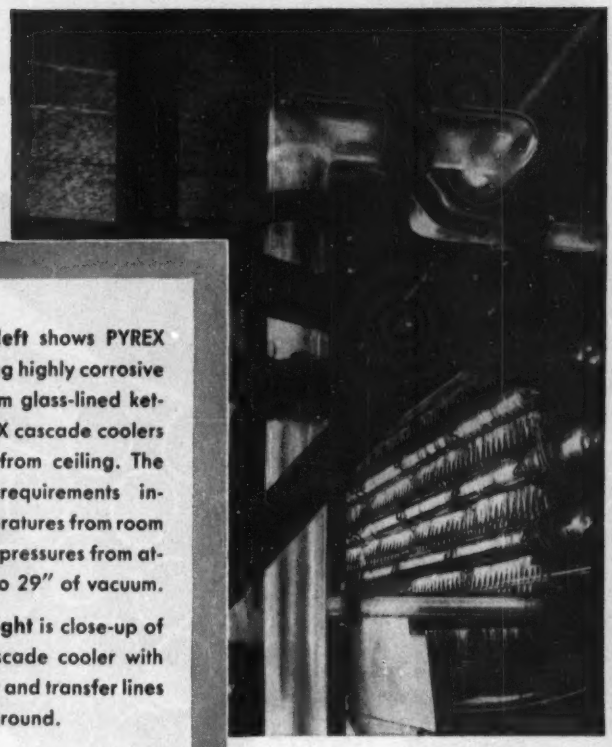
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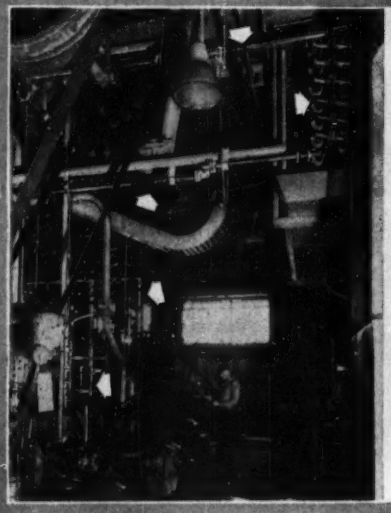


Photo on left shows PYREX pipe carrying highly corrosive solvents from glass-lined kettles to PYREX cascade coolers suspended from ceiling. The operating requirements include temperatures from room to 140° C.; pressures from atmospheric to 29" of vacuum.

Photo on right is close-up of another cascade cooler with glass supply and transfer lines in the foreground.

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MAY 1953 Chemical Engineering

Wanted: Chlorine Without Caustic

The growing unbalance between chlorine and caustic demands is focusing increased attention on alternate routes to chlorine. Here is a technical and economic survey of the most important candidate processes.

JOSEPH GORDON

When a new plant which will make only 35 tons of chlorine a day attracts more attention than much larger conventional units, there must be a reason. This interest-arousing plant is the one that Hercules Powder Co. is putting up at Brunswick, Ga., for completion this year.

Interest springs from the fact that Hercules will make this chlorine by oxidation of hydrogen chloride (HCl), without producing the caustic soda which is formed in the usual sodium chloride brine electrolysis.

Although caustic supply at present is rather evenly balanced with demand, electrolytic producers are promoting its uses with vigor. These producers well realize that, in view of the exceedingly rapid growth of chlorine demand, it is not likely that caustic needs will increase as fast. In the years ahead, profitable disposal of this caustic soda coproduct will become a problem of increasing proportions unless additional chlorine can be made without it. By 1960, it seems probable that at least 200,000 tons of chlorine yearly will be made by processes which, like the one Hercules will use, are not caustic producers.

Various approaches to this objective have been tried in the past, with better success in recent years as technological know-how has progressed and the economic climate has become more favorable. Generally, these process routes begin either with HCl or one of several salts, and include both electrolytic and nonelectrolytic methods.

JOSEPH GORDON is a chemical consultant, with offices at 545 Fifth Ave., New York. He was formerly market editor of Chemical Week.

COMPLETING THE CHLORINE CYCLE

Utilization of byproduct HCl is a natural choice, since nearly 500,000 tons of it are available from organic chlorinations, typified by the reaction

$$RH + \text{Chlorine} \rightarrow RCl + HCl$$

These chlorinated organics have been not only the prime reason for the growth of chlorine requirements but also the source of increasing amounts of HCl. Often this HCl is a disposal problem, so that a producer converting it may have the advantage of a raw material at practically no cost.

Byproduct sources account for about three-fifths of the total production of HCl. In the past five years the markets for byproduct HCl have been greatly expanded and extended; nevertheless, the supply for purposes of chemical conversion is abundant.

At Brunswick, Hercules has byproduct HCl on hand from its manufacture of toxaphene insecticide. Hercules has been bringing in chlorine from some distance away and is not in a particularly favorable spot for marketing its HCl. Such a combination of factors has made the HCl-to-chlorine process seem economically feasible at this time.

The HCl will be converted via an oxidation process that is licensed from Grosvenor Laboratories (U. S. 2,206,399) and from Dow Chemical Co. (U. S. 2,577,808). This method resembles in principle the old-time Deacon process, but substantially improved in practice. By the original Deacon process, HCl was oxidized with air over a copper chloride catalyst according to the reaction

$$4HCl + O_2 \rightarrow 2\ Cl_2 + 2\ H_2O$$

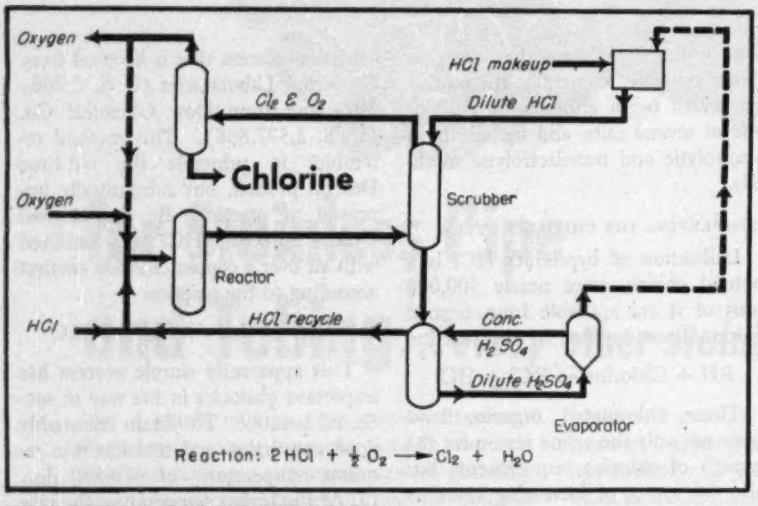
This apparently simple process has important obstacles in the way of successful practice. To obtain reasonably good conversion and reaction rate requires temperatures of 450-600 deg. C. At the higher temperature the rate is satisfactory but the equilibrium becomes less favorable. At the lower end of the temperature range the equilibrium improves but the rate slows down. Under the best conditions about 75 percent conversion of the HCl is obtainable by using an excess of oxygen or air, which still poses a difficult separation problem to recover the chlorine. Corrosion is a serious problem with these mixtures at the relatively high temperatures employed.

IMPROVING ON DEACON

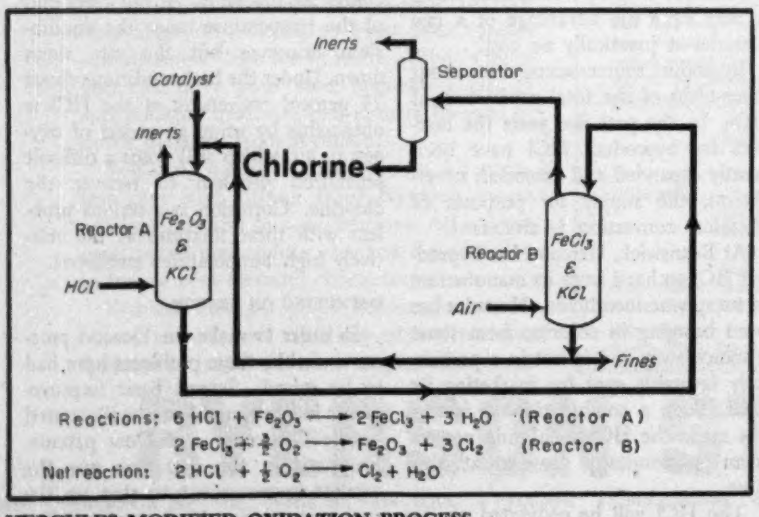
In order to make the Deacon process workable, these problems have had to be solved. Several basic improvements in the method can be illustrated in the Grosvenor and Dow patents. Emphasis in the first case was the catalyst improvement to step up the conversion rate at lower temperatures,

Non-Caustic Chlorine Processes

Chloride	How Processed	Coproducts	Commercial Status in U. S.
HCl	Oxygen	None of value	Pilot-planted during World War II
HCl	Oxygen and Fe_2O_3:KCl	None of value	35-ton plant under construction
HCl	SO_3	H_2SO_4 and SO_3	None
HCl	Electricity	Hydrogen	None
HCl	Oxygen, copper chloride and electricity	None of value	Demonstrated in pilot plant
NaCl	HNO_3	$NaNO_3$ (NOCl, NO_2)	In operation since 1935
NaCl	SO_3	Na_2SO_4 and SO_3	Pilot-planted during World War II
NaCl	Electricity	Sodium	Three producers, large scale
KCl	Electricity	KOH	Several commercial plants
Others	Electricity	Mg, Li, etc.	Mg commercial on large scale, little net chlorine produced; Li still relatively small



HYDROGEN CHLORIDE OXIDATION



HERCULES MODIFIED OXIDATION PROCESS

thereby reducing the corrosion hazards and the separation problem. Grosvenor's catalyst is mainly ferric chloride, to which potassium chloride is added to cut down volatility.

Dow's technological contribution, pilot-planted at Pittsburg, Calif., over a year's time, is a two-stage reaction, operated continuously. Ferric chloride-potassium chloride is used in one reactor, not as a catalyst but as a reactant. Air or oxygen passes over the moving bed, liberating chlorine and converting the ferric chloride to the oxide. The oxide moves on to the other reactor, where contacting with HCl brings back the ferric chloride. By Dow's improvement the equilibrium limitation of the Deacon process is largely overcome. The HCl can be almost completely utilized without recycle, thereby minimizing separation problems. Operation at lower temperatures also means less corrosion.

In the oxidation stage, either air or oxygen can be used, weighing the increased cost of oxygen against the higher conversion and easier separation it permits.

PRESENT COMMERCIAL PROCESSES

Promising as the oxidation of HCl now appears, it is not by any means the only feasible way to make chlorine without caustic. Two methods starting from sodium chloride have been in operation for some time.

One is the electrolysis of fused salt, giving sodium metal as a coproduct. This process is employed by three producers—Ethyl Corp., Du Pont, and National Distillers. Most of their sodium is needed for the manufacture of tetraethyl lead, although a number of other sizeable uses have been developed. Combined output of these three companies for coproduction of sodium with chlorine amounts to about 5 percent of today's chlorine output. The rate of future growth of fused salt electrolysis depends on the demand for TEL and on how these other uses for sodium expand.

The second process is nonelectrolytic and unique. Since 1935 it has been in operation at Hopewell, Va., by Allied Chemical, who has recently increased its chlorine capacity to about 75 tons daily. The process embodies an oxidation of salt with 65-percent nitric acid (obtained from a neighboring Allied plant) to produce sodium nitrate as the chlorine coproduct. In

addition, new uses have been developed for nitrosyl chloride and nitrogen dioxide, which are intermediates in the process.

This process offers both flexibility and interesting potentialities, but requires cheap salt and nitric acid and needs a ready market for the sodium nitrate, which is chiefly a fertilizer. The plant at Hopewell meets these requirements. Corrosion might be expected to be serious, but suitable materials of construction have been found, and temperatures are relatively low. In most of the piping and equipment ceramics, glass, lead, Koroseal and saran are satisfactory. However, where moisture is present or pressure is required, nickel or Inconel is considered essential.

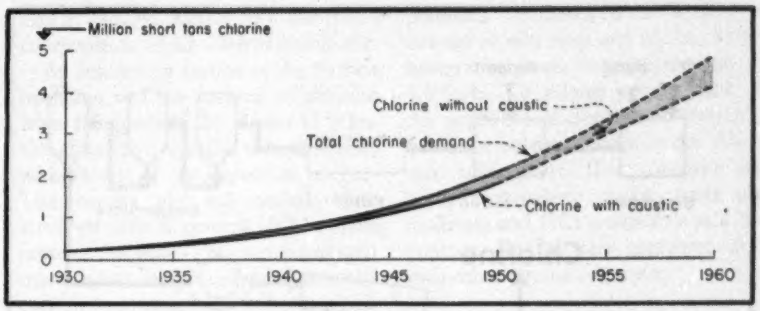
Chlorine is also made commercially without caustic soda by the electrolysis of aqueous potassium chloride brine. Aside from minor operational changes, the process is entirely analogous to the electrolysis of NaCl brine. About 1 percent of the chlorine made today is derived from potassium chloride. Expansion of this amount depends primarily on finding adequate outlets for the potassium hydroxide produced, most of which now goes into special soaps, medicinals and plant foods.

Perhaps 3 to 4 percent of present chlorine output comes from electrolysis of other metal compounds, especially magnesium and lithium. In the manufacture of magnesium from sea water, as Dow makes this metal at Freeport and Velasco, Tex., most of the chlorine is reused in the process to make the magnesium chloride for electrolysis. However, where the $MgCl_2$ is already available in bittern, as at Midland, Mich., the chlorine output is available for other purposes.

HISTORICAL BACKGROUND

These commercial plants are evidence that the manufacture of chlorine without caustic is neither new nor lacking in variety. Making them feasible has been a continued story of improvement in technology.

Actually, the Deacon process antedates the electrolysis of brine by about 25 years. It reached its height in the nineteenth century during the period the LeBlanc soda ash process was in its heyday, having plentiful quantities of HCl available. This was oxidized with air to give a dilute chlorine suitable for bleaching textiles and pulp. The product as bleaching powder sold for as high as $700 a ton, with due allowance for the low yields and difficulties with an embryonic technology.



However, with the advent of the Solvay ammonia-soda process around 1880, the LeBlanc process was soon obsolete. Shortly thereafter, before the turn of the century, the Deacon method of chlorine making faded out under the challenge of electrolytic chlorine.

During the ensuing years, constant improvement in cell design and operation and mounting demand for both its products helped to keep other chlorine processes in the background. Economic incentive was lacking, numerous gaps existed in the technology, and little byproduct HCl was available. Yet interest was alive behind the scenes, as the list of patents testifies.

In the 1920's came the development of TEL for high-octane gasoline and with it the need for sodium and chlorine. Increasing utilization of chlorine for many kinds of organic chemicals, with attendant production of HCl, marked the 1930's. The nitrosyl chloride plant was in operation around 1935 by Allied at Hopewell. Proximity of nitric acid and salt and nearby sodium nitrate markets were necessary factors in this development. Allied's more immediate incentive at that time lay in the expansion of the potential of nitrosyl chloride, an intermediate in the manufacture of its Nytron wetting agent.

Chlorine demand was growing faster than demand for caustic by the time World War II came. Wartime chlorine needs made this a runaway, with especially heavy demands for such products as TEL, ethylene glycol, phenol, DDT and vinyl plastics. These came so fast that, despite increases in private capacity and new government plants, chlorine became and stayed acutely short during 1942-1946.

This period also had important effects on the advancement of methods to manufacture chlorine without caustic. Growing production of chlorinated organics brought with it enough byproduct to become the greatest source of HCl, outranking the salt-sulfuric acid process. In the hurly-burly of war, not much attention was paid to this byproduct, though afterwards it was expected to become a disposal problem. If not recovered it was a pollution problem, and if recovered it might be a marketing problem.

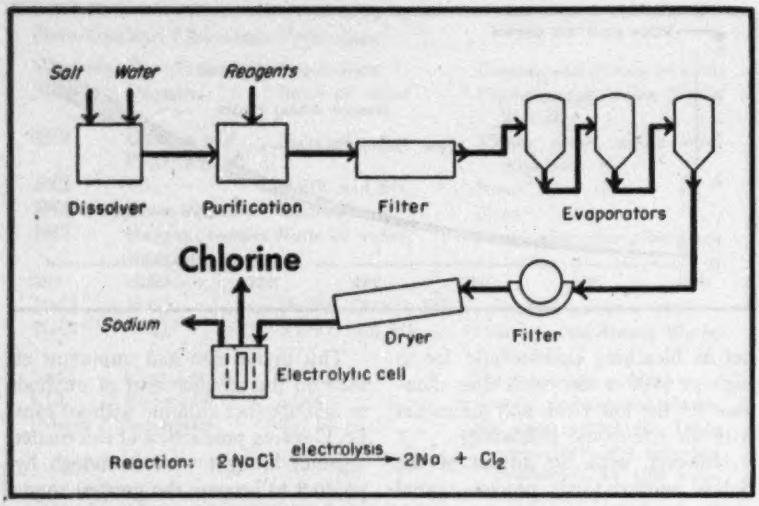
HANDWRITING ON THE WALL

During this period it was possible to foresee that if chlorine demand continued to grow more rapidly than caustic's, some feasible alternatives would have to be developed to maintain the economic balance. The shortage and rising cost trends of electric power also helped to foster the development of nonelectrolytic processes.

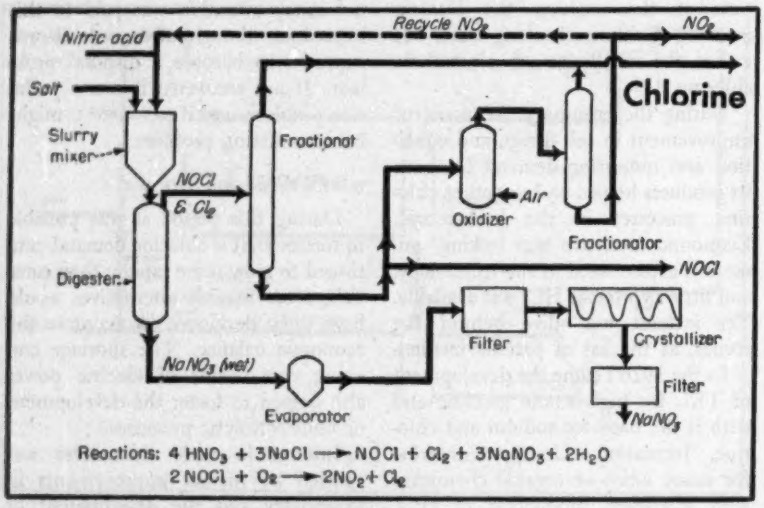
Interest in such alternatives was spurred by further improvements in technology and the development of better or cheaper materials of construction. A number of companies made progress along these lines, and some research was carried on under government aegis. Most of these concerned the recovery of chlorine from HCl.

Air Reduction Process—In a joint venture with Solvay, Air Reduction designed and operated its version of a Deacon-type pilot plant, using oxygen as the oxidizing agent and a copper chloride catalyst promoted with a rare earth chloride. Control of temperature was obtained by use of excess HCl and periodically reversing the flow in the reactor, which was lined with acid-proof refractory and packed with acid-proof tile.

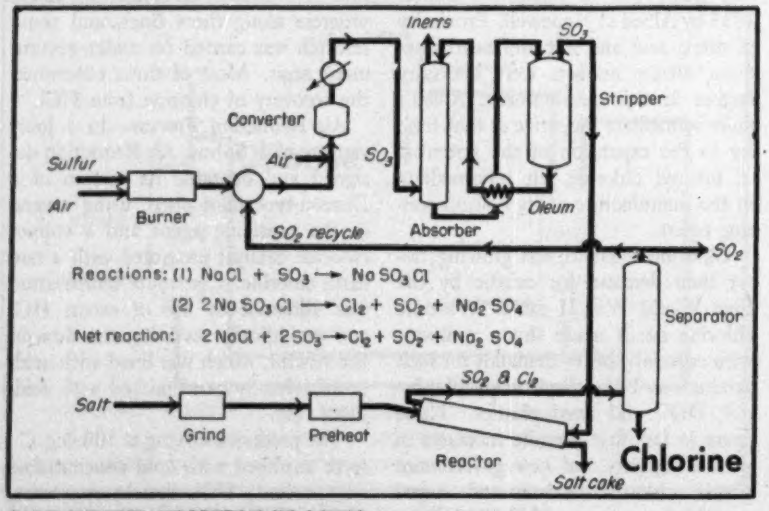
The products, leaving at 100 deg. C., were scrubbed with cold concentrated (36 percent) HCl, thereby recovering the unreacted HCl and the water pro-



ELECTROLYSIS OF FUSED SALT



ALLIED NITROSYL CHLORIDE PROCESS



SALT-SULFUR TRIOXIDE PROCESS

duced to make additional concentrated acid. A scrubbing followed with dilute 22 percent HCl, which, in turn, was fortified to 36 percent. The strong HCl stream was heated in a packed column, giving an overhead hydrogen chloride recycle and a residuum of 22 percent HCl, part of which went to the absorber and the rest to a sulfuric acid dehydration step, emerging as strong acid. (The dilute sulfuric could be brought up to strength by vacuum evaporation and returned to the process.)

Finally, the gases from the absorber, after drying with sulfuric, were cooled and then liquefied in a two-stage compression using a Nash pump. Starting with 95 percent oxygen in the reactor feed and with an HCl:oxygen ratio of 10, the recovery of chlorine at 80 psi. and −50 deg. C. was better than 99 percent.

Salt-Sulfur Trioxide—During the war and even before, investigations of this process were made, some on a pilot-plant scale. This method consists first in the absorption of sulfur trioxide by salt at a relatively low temperature. Depending on the conditions, the ratio of trioxide to salt in the product, sodium chlorsulfonate, may range from one to two on a molal basis.

This intermediate, upon heating to around 275 deg. C., dissociates into chlorine, sulfur dioxide and sodium sulfate. The latter two are valuable byproducts. Sodium sulfate could be used in making kraft paper, in glass manufacture, or for other purposes. The sulfur dioxide, after separation from the chlorine, may either be sold or recycled to the process.

Despite these credits, a number of factors in this process are somewhat unfavorable: (1) Large heat requirements; (2) side reactions and difficulties in achieving complete dissociation of the sodium chlorsulfonate; (3) corrosion under the conditions employed; and (4) separation of the sulfur dioxide from the chlorine.

The separation of these gases has been the subject of much research and many patents. Three of the more promising ones depend on selective oxidation, selective absorption in a suitable solvent, or formation of sulfuryl chloride SO_2Cl_2 from the azeotrope. One illustration of the second type is the selective absorption of chlorine from the mixture by a suitable chlorinated solvent, such as sulfur

monochloride or carbon tetrachloride.

Two Du Pont patents (U. S. 2,381,876 and 2,401,644) offer a basis for the third of these separation processes. According to these patents, the 50-50 mixture from the reaction is fractionated to give sulfur dioxide and the azeotrope (containing 88 mole percent chlorine and 12 mole percent SO_2). The azeotrope is converted to sulfuryl chloride, from which the excess chlorine is separable by fractionation. The sulfuryl chloride can then be converted to sulfur dioxide and chlorine, and the separation cycle repeated.

Despite the aforementioned difficulties in the process, improvements during the war have helped to make it more feasible. Economically, much depends on the market for the byproducts, since nearly two tons of salt cake and one ton of sulfur dioxide are made with every ton of chlorine.

HCl-Sulfur Trioxide—Similarities between this and the preceding process are readily apparent. If the HCl is made from salt and sulfuric acid, the same products are obtained; if byproduct HCl is used, sulfuric acid is made instead of sodium sulfate. Investigations of the several phases of this process were made during the war, but as far as it can be determined, no pilot plants were operated in this country. However, the research that has been done indicates that each reaction step takes place smoothly, with good yields.

First step is the reaction to form chlorsulfonic acid at 70-100 deg. C.; second, the dissociation to sulfuryl chloride and sulfuric acid at 200-300 deg. C.; and third, the decomposition of sulfuryl chloride at around 200 deg. C. to give sulfur dioxide and chlorine, which may be separated by methods previously mentioned. The process avoids some of the difficulties of the salt-sulfur trioxide reaction, offers valuable byproducts, and seems to warrant further consideration, especially if cheap sulfur trioxide is available.

PROGRESS IN GERMANY

IG Farben Process—Shortly after V-E day, an Allied Technical Mission found in Oppau, Germany, an IG Farben pilot plant which had been making 10 tons of chlorine daily by the oxidation of HCl. Plans for expansion to 25 tons had been curtailed because of the war. This plant used a molten mixture of potassium chloride and ferric chloride as catalyst, similar to Grosvenor's composition which Hercules will use.

An interesting feature of the Farben oxidation was the removal of chlorine from the products by means of selective absorption in sulfur monochloride, with recycle of the unreacted oxygen. The reactor gas was cooled, then scrubbed with 36 percent HCl to make more of the same. The chlorine-oxygen mixture was cooled and dried countercurrent to concentrated sulfuric, which could be refortified in a vacuum evaporator. The dry gases were scrubbed with sulfur monochloride under pressure (8 atm.), preferentially absorbing the chlorine, and recycling the oxygen and some of the nitrogen if air was used in the oxidation. Chlorine was desorbed under pressure and was directly liquefiable under these conditions without refrigeration.

HCl Electrolysis—German technologists had also developed an electrolytic method to make chlorine by electrolysis of concentrated hydrochloric acid. A cell based on the process was operated at Wolfen, and despite the numerous difficulties encountered in cell design and construction, the unit appeared to work satisfactorily.

In this country, Frank Low of Westvaco proposed a two-stage process to avoid some of the problems besetting the direct HCl electrolysis. A pilot plant based on this process was designed and operated successfully by a Westvaco group under the supervision of C. P. Roberts.

The Westvaco process employs the electrolytic reduction of cupric chloride, rather than HCl. In this electrolysis, chlorine is produced, along with cuprous chloride. In a second stage, the cuprous chloride is oxidized with air in the presence of HCl to regenerate cupric chloride. Other metallic chlorides can be used in place of the chloride of copper, but Westvaco has found none so suitable. The chief requirements are low electric power consumption in the first stage and comparative ease of oxidation with air in the second.

According to Westvaco's findings, this process is superior to direct HCl electrolysis in simplicity of construction and smaller power cost. At a current density of 100 amp. per sq. ft., the indirect process uses 0.4 kwh. per lb. of chlorine, compared to 0.8 kwh. for direct HCl electrolysis. However, preferred operation is at a current density of 400 amp. per sq. ft., which brings the power requirements up to 0.8 kwh. To a large extent, most of the problems of design and construction have been overcome in the Westvaco pilot plant. The company believes that where power costs are moderate and HCl is available as a byproduct, this process compares well with other alternative routes.

PROSPECTS ARE STRONG

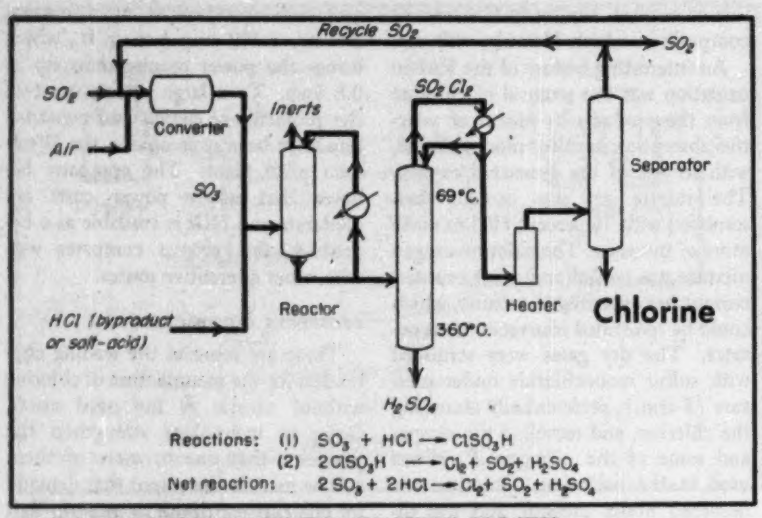
These are some of the leading contenders for the manufacture of chlorine without caustic as the need arises. Gains in technology strengthen the prospects that one or more of them will be used to the extent that demand for chlorine continues to outstrip that for caustic. The timetable of this trend has been pushed up by the defense program, which is bringing a 50 percent increase in electrolytic capacity in a period of less than four years.

However, the shift towards other methods of making chlorine will be more gradual than would be expected on the basis of past growth. Compared to an annual growth rate of about 11 percent for chlorine in the past thirty years, the next ten will probably see an increase of around 8.5 percent.* Meantime, the growth in demand for caustic at present price levels will probably be around 5 percent.

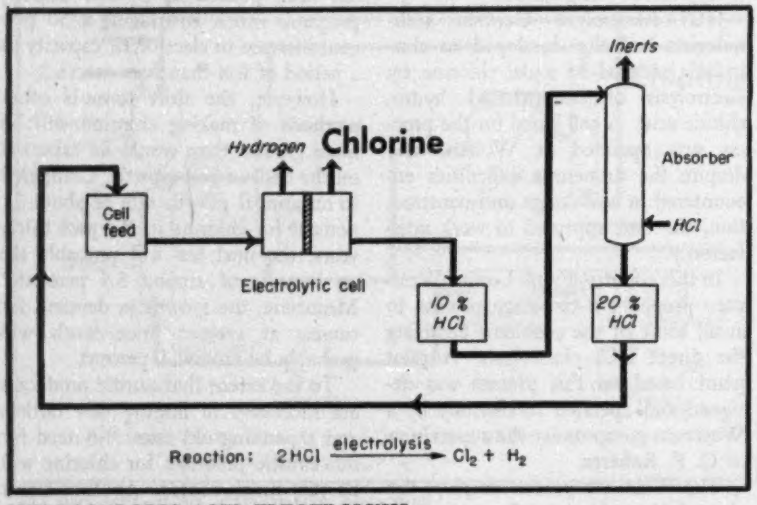
To the extent that caustic producers are successful in finding new outlets and expanding old ones, the need for non-caustic processes for chlorine will be that much abated. Another factor that would check the trend, especially during the next ten years, is the likelihood that less caustic will be produced from soda ash. At the present time between 15 and 20 percent of the caustic supply is made from soda ash. However, the increased cost of making soda ash and the resulting pressure for higher ash prices portend the eventual loss of the bulk of this caustic supply. By 1960, this curtailment should amount to about 350,000 tons, about 10 percent of today's total caustic supply. This, of course, would mean a better market for electrolytic caustic.

For the long-range outlook, utilization of HCl assumes primary importance. If profitable markets continue to develop for HCl as an industrial

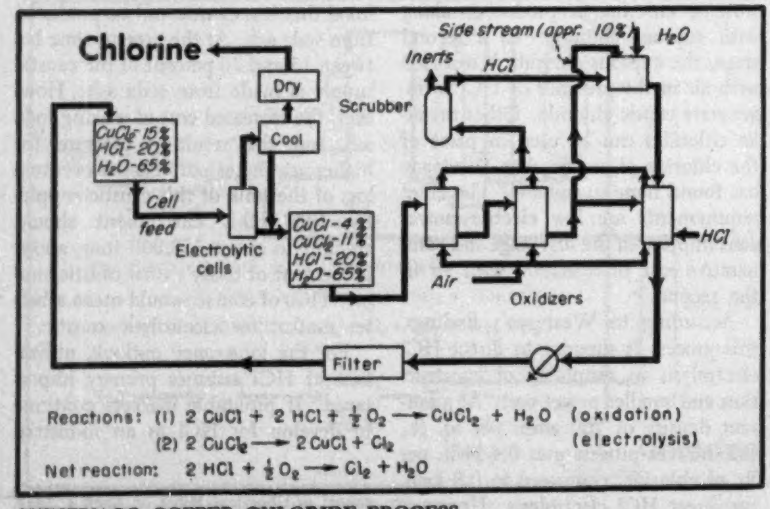
* For basis of these trends, see author's report in *Chemical Week* of April 4, 1953, page 28.



HYDROGEN CHLORIDE-SULFUR TRIOXIDE PROCESS



HYDROCHLORIC ACID ELECTROLYSIS



WESTVACO COPPER CHLORIDE PROCESS

acid, less acid becomes available for chemical conversions, and the incentive for such conversion is also reduced.

Despite marked improvement in the economy and range of HCl transportation, about half the supply of byproduct should be available for chemical conversion. This would be by either of two routes—using the HCl to make chlorine, such as outlined in this article, or using the HCl instead of chlorine, thereby conserving chlorine supply and correspondingly reducing chlorine demand. This latter use is exemplified by the Raschig phenol process or the production of vinyl chloride and ethyl chloride with HCl.* Other HCl possibilities in chlorine conservation are in such important applications as Dow's magnesium-from-sea-water process, in making titanium chloride and other cases where chlorine is now used.

Finally, in gaging these long-range trends, it should not be overlooked that manufacturing and shipping economies in electrolytic chlorine-caustic will naturally enhance its competitive position vis-a-vis these other chlorine processes. Much has been done along these lines during the past few years. In manufacturing, the trends have been toward larger and more efficient cells and making use of the byproduct hydrogen for ammonia production and other processes. In shipping, some of the most notable signs have been the greater use made of water transport; larger unit cars for chlorine; and shipping more caustic in the form of 73 percent solution, rather than as 50 percent.

ONLY QUESTION OF TIME

All these considerations will have a bearing on when, where and to what extent any of these processes to make chlorine without caustic will be needed. However, the evidence that they will be needed seems to be convincing.

Most of this additional chlorine would be derived from byproduct HCl, and the Deacon process appears to be more generally applicable for more locations than the other candidate processes. All of them are technologically feasible, although further refinements are to be expected.

These processes seem entirely com-

* But not where the HCl is made by combustion of chlorine and hydrogen.

parable on the basis of operating cost. Almost all of them are in the bracket of $25 to $35 per ton of chlorine output for plants that make 35 to 50 tons of chlorine a day.

The modernized Deacon process as a source of chlorine will come in for serious consideration when a supply of byproduct HCl exceeding 25 tons a day is available; when the need for chlorine is much heavier than the need for caustic; and when the HCl is not readily marketable or usable nearby. The new Hercules plant meets these criteria and, in addition, the freight bill on its purchased chlorine is another persuading influence. Other byproduct HCl producers who are somewhat similarly situated from an economic standpoint will be subject to a similar pull, but in varying degrees depending on the particular size and site of their operations. What an operator would do who makes electrolytic chlorine-caustic and also has large amounts of HCl resulting from chlorinations—as quite a few have—is yet another case to be settled.

Of the other processes that make chlorine without caustic, practically all of them are competitive process-wise, but of more limited application for various reasons. The chlorsulfonic process should have a source of byproduct sulfur trioxide, though a nearby source of brimstone or byproduct sulfides might be adequate. Electrolytic methods to get chlorine from HCl are specific for areas where power is cheap and markets for caustic only lightly established. The Westvaco process seems to have a definite edge over direct HCl electrolysis in such instances.

The nitrosyl chloride process used by Allied has considerable flexibility and should see further growth, provided suitable markets are found for the sodium nitrate and other products which the plant can produce. Other and equally desirable sites are limited in number, but the process starting with salt, rather than byproduct HCl, can be of a size geared to the market rather than the amount of raw material.

Making chlorine from salt and sulfur trioxide also has a similar potential advantage. A near-at-hand market for the sodium sulfate and sulfur dioxide produced is a necessity, however, and the sulfur trioxide should preferably be byproduct. Despite some difficulties which seem inherent to this process, a plant making chlorine this way might enjoy success near a center of pulping operations in the South.

On the basis of economic estimates, the annual market for chlorine without caustic will be about 200,000 to 300,000 tons greater in 1960 than now. Part of this will be supplied by expansion of existing electrolytic non-caustic processes, but most will come from non-electrolytic processes starting with HCl. The potential in the next eight years should be 10 to 20 times as big as the new Hercules plant capacity, though probably less than 5 percent of the expected chlorine output at that time.

CHOICE OF ALTERNATIVES

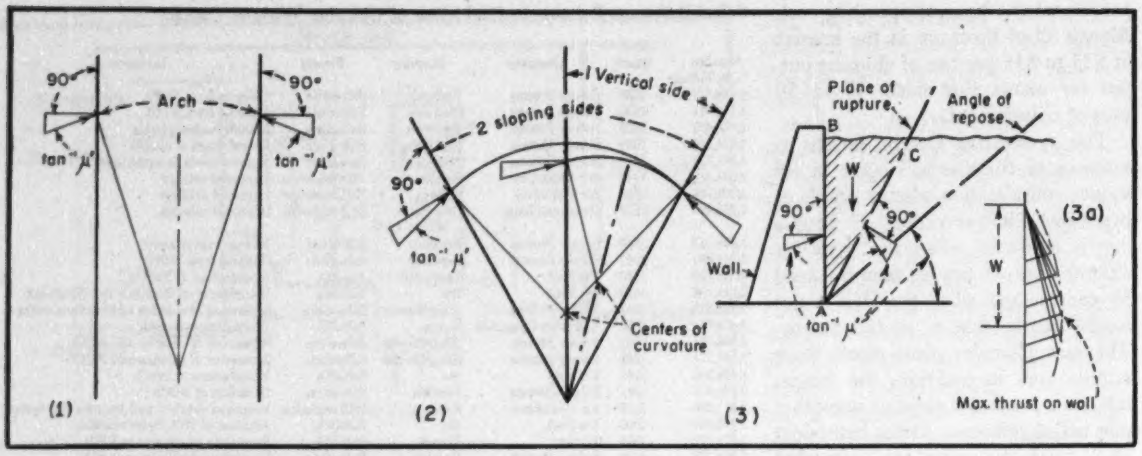
For those who seek to apply these new developments, the problem will consist largely in matching the process to the operation and location. Meanwhile, modern technology and economics have streamlined and rejuvenated the once-moribund Deacon process. The last word is yet to be spoken—there is still room for improvement and further developments. But even now, sound chemical engineering has provided more flexibility in chlorine production and has removed a possible barrier to chlorine growth.

Selected Patents Relating to Production of Chlorine Without Caustic

Number	Year Issued	Company	Inventor	Process	Invention
U. S. Patents					
2,138,016	1938	Solvay Process	Beekhuis	Salt-nitric	Chlorine from NOCl
2,138,017	1938	Solvay Process	Beekhuis	Salt-nitric	Chlorine from NOCl
2,148,429	1939	Solvay Process	Beekhuis	Salt-nitric	Manufacture of nitrate
2,181,559	1939	Solvay Process	Beekhuis	Salt-nitric	Manufacture of nitrate
2,201,423	1940	Solvay Process	Beekhuis	Salt-nitric	Improvements in equipment
2,204,172	1940	Air Reduction	Balcar	HCl oxidation	Improved catalyst
2,204,733	1940	Air Reduction	Miller	HCl oxidation	Improved catalyst
2,206,309	1940	Grosvenor Labs.	Grosvenor-Miller	HCl oxidation	Improved catalyst
2,208,112	1940	Solvay Process	Beekhuis	Salt-nitric	Process improvement
2,211,531	1940	Solvay Process	Beekhuis	Salt-nitric	Chlorine from NOCl
2,218,729	1940	Du Pont	Tauch-Iler	Salt-SO_3	Manufacture of $NaSO_3Cl$
2,219,103	1940	Du Pont	Iler	Salt-SO_3	Manufacture of $NaSO_3Cl$ and NH_4SO_3Cl
2,228,273	1941	Solvay Process	Klingelhoefer	Salt-nitric	Separation of chlorine and nitrogen oxides
2,254,014	1941	American Cyanamid	Laury	Salt-SO_3	Process improvement
2,258,771	1941	Solvay Process	Klingelhoefer	Salt-nitric	Separation of chlorine and NOCl
2,258,772	1941	Solvay Process	Klingelhoefer	Salt-nitric	Separation of chlorine and NOCl
2,259,248	1941	Du Pont	Iler	Salt-SO_3	Manufacture of SO_2Cl_2
2,261,329	1941	Solvay Process	Beekhuis	Salt-nitric	Oxidation of NOCl
2,271,056	1942	Air Reduction	Balcar	HCl oxidation	Improved catalyst and temperature control
2,276,041	1942	Du Pont	Iler	Salt-SO_3	Addition of HCl, faster reaction
2,276,079	1942	Hooker	Maude	Salt-SO_3	Separation of chlorine and SO_2
2,296,328	1942	Solvay Process	Beekhuis	Salt-nitric	Separation of chlorine and NO_2
2,297,281	1942	Solvay Process	Beekhuis	Salt-nitric	Oxidation of liquid NOCl
2,330,114	1943	————	De Jahn	HCl oxidation	Promoted catalyst, excess HCl
2,340,961	1944	Chemical Foundation	Hixson-Miller		Separation of chlorine and SO_2
2,375,001	1945	Du Pont	Iler	Salt-SO_3	Oxidation of chlorine-SO_3 mixture
2,375,002	1945	Du Pont	Iler-McAdam	Salt-SO_3	Oxidation of chlorine-SO_3 mixture
2,375,011	1945	Du Pont	McAdam	Salt-SO_3	Separation of chlorine and SO_2
2,377,138	1945	Solvay Process	Farrell-Eichelberger	Salt-nitric	Separation of chlorine and SO_2
2,381,876	1945	Du Pont	Carlson	Salt-SO_3	Azeotropic separation of chlorine and SO_2
2,393,229	1946	Hercules	Bouchard		Separation of chlorine and SO_2
2,401,644	1946	Du Pont	Iler	Salt-SO_3	Separation of chlorine and SO_2
2,415,152	1947	————	Thomsen	Combination	Salt + SO_2 → HCl; HCl oxidation → chlorine
2,415,358	1947	American Cyanamid	Laury	Salt-SO_3	Manufacture of chlorsulfonates
2,418,930	1947	Socony-Vacuum	Gorin	HCl oxidation	Two-stage with air and copper chloride
2,418,931	1947	Socony-Vacuum	Gorin	HCl oxidation	Regeneration of copper catalyst
2,436,870	1948	Standard Oil Development	Murphree	HCl oxidation	Two-stage with fluidized metal oxide catalyst
2,468,766	1949	Westvaco	Low	Electrolysis	$CuCl_2$ electrolysis and reoxidation
2,470,073	1949	Westvaco	Low	Electrolysis	Cell design for above
2,577,808	1951	Dow	Pye-Joseph	HCl oxidation	Two-stage moving-bed catalyst (Fe_2O_3)
Foreign Patents					
Br. 584,790	1943	Standard Oil Development	Richardson-Pierce	HCl oxidation	Oxide catalyst
Can. 439,226	1947	Standard Oil Development	Richardson-Pierce	HCl oxidation	Chromium oxide catalyst
Can. 458,795	1949	Westvaco	Low	Electrolysis	Cell design for polyvalent chloride electrolysis
Can. 458,796	1949	Westvaco	Low	Electrolysis	Polyvalent chloride electrolysis and chlorine recovery

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2. Johnstone, H. F., "Chlorine Production, Nonelectrolytic Processes," *Chem. Eng. Prog.*, **44**, 657 (1948).
3. "Waste Hydrogen Chloride?" *Chem. Ind.*, **63**, 371 (1948).
4. "Beats Deacon," *Chem. Ind.*, **66**, 501 (1950).
5. Roberts, C. P., "Electrolytic Recovery of Chlorine from Hydrogen Chloride," *Chem. Eng. Prog.*, **46**, 456 (1950).
6. "Commercial Debut," *Chem. Week*, Jan. 19, 1952, p. 48.



THEORY can aid practice in improving your . . .

Design of Hoppers for Use

Many bulk materials tend to arch and "hang up" in storage hoppers. But the trouble will often yield to a mingling of sound theory with good practice in hopper design. Here's how.

CHESMAN A. LEE

Structural engineers agree on the theoretical basis for designing storage hoppers for *strength*. For them a bin is merely a group of surfaces loaded with pressure forces according to the theory laid down by Coulomb (circa 1795). Rankine and many others carried on the theoretical work. Development was stimulated by the collapse of a large bunker at Paterson, N. J. in 1897 and a consequent discussion over a period of months in *Engineering News*. There is no longer any excuse for the structural failure of a storage hopper.

On the other hand, failure of an overhead storage bin to be easy to use —that is, to discharge its contents easily—is rather common, but not very spectacular. No books have been written about it and no fellowships have been established to study the problem. The many failures along this line have been countersigned by dents hammered into the lower hopper walls in the effort to develop and maintain a satisfactory flow.

It has been suggested that rheological theory could be refined with further study so as to cover the flow of solid material through storage hoppers. The idea is that by knowing more about flow of materials we could do more about inducing hopper flow. It is my claim that there is no basis for this hope. Instead, I believe there is a simpler solution and that we already have sufficient theoretical knowledge to cover the situation. We need guidance in projecting available theory into practice. The same distribution of pressures exists in the use of a hopper as was made the basis of structural design—but Coulomb's theory should be sufficient for our needs.

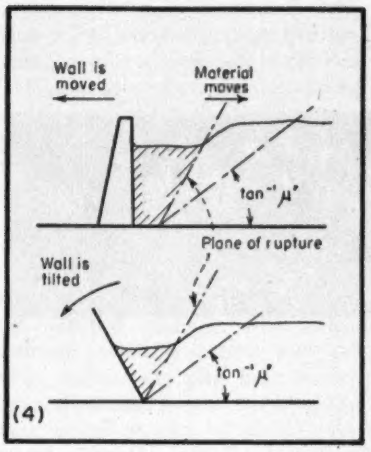
Those with time for study will be well rewarded by reading the old classics—Ketchum's "Wall, Bins, and Grain Elevators," and Cain's "Earth Pressures, Walls and Bins." A recent book of interest is Terzaghi and Peck's "Theoretical Soil Mechanics in Engineering Practice" (John Wiley & Sons, 1948).

So far most of the thinking along this line seems to have done by so-called "practical men." Some very plausible features of design have been suggested and at least one was patented. When one of these features is not completely successful, it is easy to excuse because of the particular material being handled. In other words: we expect some trouble with most materials—and a lot of trouble with some. We can achieve a high degree of satisfaction, and with it economical design, if we can re-word that statement as follows: avoid trouble with most materials, and minimize the trouble with some of the others. While a theoretical basis is required for our design, I believe such theory is not too complicated for the practical man to understand. This article hopes to make it clear.

The first thing to do is to clear away certain ideas that interfere with our grasp of the problem. It can be stated that granular materials move downward towards the hopper outlet in streamline flow, but that non-granular and cohesive materials move by the continual collapsing of arches at various heights above the outlet. For some materials the word "continuous" can be substituted for "continual" and

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C. A. LEE, *engineer with Darling & Co., Chicago, for more than 30 years, has a flare for putting fundamentals to practical use. Readers will remember his latest article, April 1952, in which he discussed both good—and fallacious—ideas in hopper design.*



those materials may be regarded as granular. It is evident that observation based on one type of flow can not be expected to govern successful design with the other type of flow. For instance a vertical side in a hopper will actually speed up the discharge of a batch of granular material, but is slightly detrimental in the case of materials which arch. This has been found to be true and in both cases is strictly in accord with expectation based on theory. Restated: flow itself is not ordinarily a problem; the problem is to get flow started in the first place.

WHAT CAUSES ARCHING

At this point a simplified discussion of arch action seems to be in order. An arch may be considered as a curved system of pressure forces springing from one supporting surface to the other. This definition is convenient in explaining the way granular materials—such as grain—act in deep bins; and also in explaining the slight reduction in pressure actually observed with granular materials at the foot of a vertical side in a shallow bin. It would be natural to assume that arch forces intersect the wall at 90 deg., but this is not so. Assume material flowing downward between two parallel walls. There is pressure against the walls and a frictional drag. For a unit height a triangle of forces may be drawn as shown in Fig. 1. The lateral forces, it is evident, must be inclined at the wall but are horizontal at the center. Thus we have an arched system of pressure forces between two parallel walls.

It is not so obvious that the lateral forces at the wall are inclined (at the same angle) even under static conditions, i.e., with materials at rest. However the well-known Janssen analysis for pressures in a deep bin is based directly on that assumption. Arch action is postulated even for granular material at rest in the bin. This analysis may seem far-fetched but the only other solution known to me, the one developed by Wilfred Airy, is considerably more complicated. The Janssen analysis gives results closely in accord with experimental findings.

An arch may be more conventionally defined as the structure containing the system of compressive forces. In the case of granular materials the arch is not self-supporting but rests upon material beneath. With that understanding, this definition is quite consistent with the Janssen analysis. This second definition has obvious application to cohesive materials. Assume an irregular arch left after material beneath has been discharged. There are two destructive tendencies: Material hanging from arch may fall, pulling material with it out of the arch proper; material in the arch is under compression and there is a spalling tendency on the lower side of the arch. If the span is too great, the arch collapses and material is discharged. On the other hand, arching with a high degree of curvature is inherently stronger. Compressive forces on the under side are less, and so is the spalling tendency.

We have already seen that a vertical side in a hopper speeds up the discharge of granular materials, but is a hindrance with cohesive materials. We are now ready to explain and justify these statements. In Fig. 2 the compressive forces in an arch intersect the wall at the angle 90 deg. + $\tan^{-1}\mu'$. Here μ' is the coefficient of sliding friction of material against wall. The center of curvature is located easily as the intersection of the normals drawn to the force resultants at the walls. In Fig. 2 two diagrams have been combined. One is for a symmetrical hopper; the other shows the effect of making one side vertical. Obviously the arch is inherently stronger (shorter radius of curvature) with a vertical side. Experiment shows that a vertical side reduces the pressure on the bottom even with granular materials. More of the weight is carried by friction, that is, by the walls themselves.

We must now reconcile these statements with the experimentally determined fact that a vertical side speeds up the discharge of granular materials. Material does not slide down the sloping sides of a hopper bottom until material in line with the opening has been discharged. Even with granular material, it slides down a fairly well defined surface (plane of rupture) which is rather steeply inclined. This surface will be discussed later. The point of interest now is that there is more friction when material slides on itself than if it were sliding on the side of the hopper. A straight side provides an appreciable area with a lower coefficient of friction, and free flow is speeded up accordingly. Thus a straight side speeds up the free flow of granular material but is detrimental with materials that arch. Hence there is no inconsistency.

WEDGE OF MAXIMUM THRUST

Referring to Fig. 3, the wedge of material above the arbitrarily selected plane *AC* may be considered as trying to slide down that plane. It is held in position by the plane and the retaining wall *AB*. A triangle of forces may be drawn using the resultants of the sev-

(*Continued on page 200*)

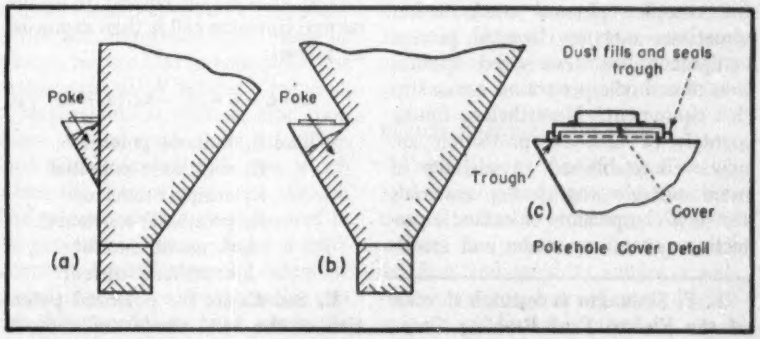


Fig. 5—POKE HOLES, and a dust-sealed cover, are useful details.

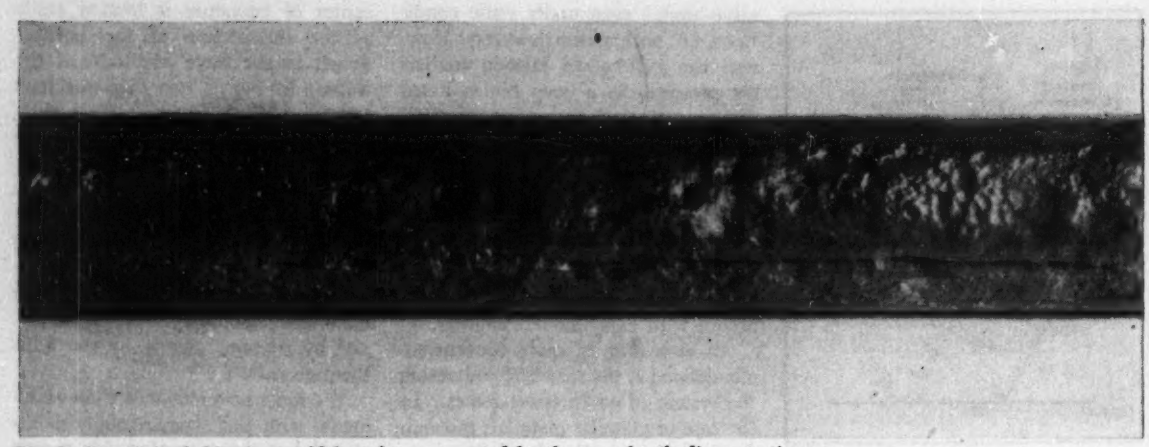


Fig. 1—Corrosion of this pipe could have been prevented by the use of cathodic protection.

Cathodic Protection Can Save Chemical Process Equipment

Techniques are developed to the point that application to chemical process equipment can now be made. Here's a summary of the know-how to date that may help cut your corrosion losses.

L. P. SUDRABIN

Widespread recognition of cathodic protection for the prevention of corrosion on buried oil and gas pipelines and on various steel structures submerged in water has directed considerable interest toward its application to chemical process equipment.

Objectives when considering the use of the cathodic protection principle are: (1) use of steel or less costly alloys for the fabrication of process equipment, (2) extending the service life of present process equipment, (3) reducing contamination of the product, and (4) practical and economic maintenance of existing buried or submerged plant structures.

Intense corrosive conditions and the complex physical conformation sometimes met in chemical process equipment has discouraged application of cathodic protection systems to this equipment. Nevertheless, fundamentals of cathodic protection are now well established. Availability of more suitable engineering materials for such components of cathodic protection systems as anodes and insulation encourage extending its use to corrosion problems heretofore considered as doubtful applications.

L. P. SUDRABIN *is research director of the Electro Rust Proofing Corp., Belleville, N. J.*

What It Is

Cathodic protection is the use of an applied current from an auxiliary anode to prevent or retard the corrosion of a metal which has been made the cathode in the corroding media.

A concept helpful in understanding the relationship between potential, resistance, and current found in a natural electrochemical corrosion cell and in the application of cathodic protection can be established by the use of Kirchoff's laws.

The local action current i_L in the natural corrosion cell is then expressed as follows:

$$i_L = i_a = i_c = (E_a - E_c)/(R_a + R_c) \quad (1)$$

Where E_a = anode potential
E_c = cathode potential
R_a = anode resistance
R_c = cathode resistance
i_a = anode current
i_c = cathode current

E_a and E_c are the polarized potentials of the local anode and cathode respectively, and represents the open circuit potential and the complex effect of the e.m.f. developed by concentration polarization. The *IR* drop form of polarization caused by the resistance element is considered separately.

The effect of an applied protective current i_p upon the corrosion current in flowing into the electrolyte from the anode (1 amp./yr. represents about 20 lb. of iron) can be best understood when we assume that E_a, E_c and R_a and R_c are unchanged at the instant that the protective current is applied or interrupted.

$$i_a = (E_a - E_c)/(R_a + R_c) - i_p\,(R_c)/(R_a + R_c) \quad (2)$$

Thus, it can be seen that the corroding anodic current i_a, at the instant protection is applied, is equal to the local action current i_L less a portion of the protective current i_p which is determined by the function $R_c/R_a + R_c$. Protection is complete when $i_a = 0$.

The positive current I_p for full protection is:

$$I_p = (1 + R_a/R_c)\,(E_a - E_c)/(R_a + R_c) \quad (3)$$

A study of these relationships show that factors which increase the rate of depolarization will increase the local

action current i_L in the natural corrosion cell as well as the protective current I_p needed for complete protection.

Higher concentrations of oxidizing agents (such as Cl_2, O_2, Fe^{+++}), temperatures, and velocities are among the environmental factors which increase protective requirements.[20]

Deposited coatings such as $CaCO_3$, which impede O_2 diffusion, and resistive coatings will reduce the protective current requirements. Among the resistive coatings with which cathodic protection is often used are vinyl coatings and glass fibre and/or asbestos-reinforced coal tar enamels. Best overall results are usually obtained when the cathodic protection is controlled so that corrosion activity at the coating flaws ceases, and no excess current is applied to damage the coatings by ampere hour effects such as hydrogen evolution, production of alkali, and electroendosmosis.[9]

Best corrosion control procedure for a specific problem may be a combination of one or more of the conventional methods: coatings, materials, chemical treatment, and cathodic protection. Cathodic protection is unique in that it is a dynamic effect which can overcome all corrosion current whereas the other methods impede corrosion current by resistive or polarization effects.

Eq. 3 suggests that at any instant the applied current required to stop corrosion is never less than the local action current but can be greater as determined by the ratio of R_a/R_c. The cumulative polarization effects of the applied current may in time lower the protective current requirements below the initial local action current of the unprotected metal. In some instances, where the protective current reduces the resistive cathode film, the protective current requirements conceivably can increase with time.

Though some similarity exists in the influence of environmental factors upon the local action current and the total protective current required, a consistent proportionality between the two does not exist.

Since it has been shown that at any instant the protective current requirements are at least equal or greater than the local action current, a rough approximation of the protective current needed may be obtained by multiplying the current equivalent to the local action corrosion by 2 and 3 respectively. It becomes evident that in instances of high penetration rates very large protective current flows will be needed.

Local Action Current Equivalent for Iron

Corrosion Rate In. per Yr.	Equiv. Current Density, Ma. per Sq. Ft.
0.001	0.8
0.01	8
0.1	80
0.25	200
0.50	400

In many instances the high protective current and large equipment requirements would eliminate consideration of cathodic protection by economic and/or practical factors.

Anode Selection

Some typical anode materials used in applying protective current are shown in Fig. 2. The selection of anode material and current source is often determined by economic and physical factors rather than permanence of service.

Platinum is often used in the form of a small diameter wire or by cladding a rod of copper, nickel, or other conductor. An insulated conductor contacting the platinum wire at frequent intervals along its length overcomes the rapid attenuation of protective potential resulting from the comparatively high lineal resistance of the platinum wire. A rectifier or other source of d.c. potential is used to apply the protective current from the platinum anode. Since platinum usually exhibits noble properties in nearly all environments, the anodic reaction results in the production of O_2 or Cl_2, etc. The economics and practice of using platinum anodes require careful consideration.

Aluminum anodes are electrochemically consumed by the protective current with the formation of Al^{+++}. The light weight, conductive properties, and the formation of $Al(OH)_3$ which is not too objectionable in many instances, has resulted in widespread use of this material. A rectifier is required.

Magnesium, as well as zinc, possesses an inherent potential difference when coupled with iron which causes the flow of protective current. The galvanic anodes are consumed in the protective process. Since a comparatively limited potential difference is available to drive the protective current these anodes are used where the electrolyte conductivity is sufficiently high or in cases where the protective current requirements are low. Magnesium is cast in slabs or extruded into bars or tape allowing a wide range of forms to meet in the design requirements of cathodic protection.

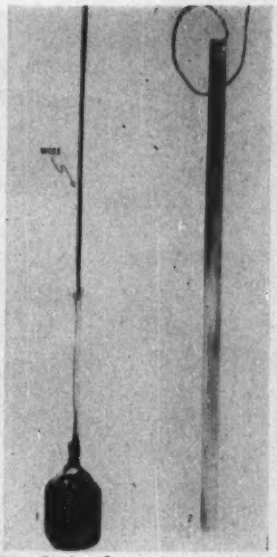


Fig. 2—Anodes.

Graphite anodes exhibit some non-sacrificial properties and require a rectifier. In soils a granular coke breeze backfill is used to permit the gas formed to disengage from the anode. Cl_2 is generated on the graphite anode in sea water and salt brines. The O_2 anodically generated in sulphate solutions will cause more rapid deterioration of the graphite anode.

Magnesium anodes buried in soil are usually surrounded by a backfill of bentonite-gypsum and 5 percent sodium sulfate to obtain the maximum protective output with the least amount of self-corrosion.

Applications

Most of the conventional applications of cathodic protection on steel are in corroding environments having a pH range from about 5.0 to 10.0.

BURIED PIPELINES AND TANKS

Protection of buried pipelines is probably the best recognized application of cathodic protection. One oil refinery is impressing by means of rectifiers and graphite anodes a protective current flow of over 12,000 amp. to its buried piping.[11]

Correction of stray current effects

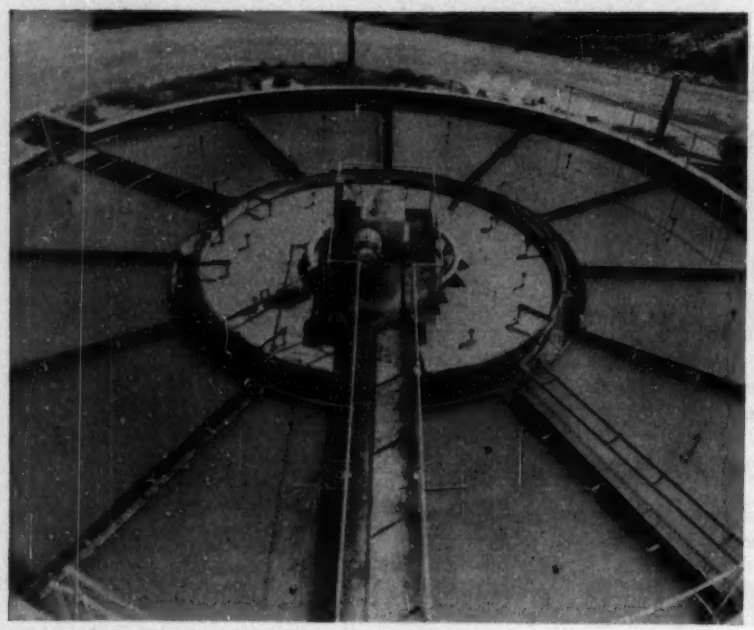


Fig. 3—Clarification equipment. Note rectifier and anodes.

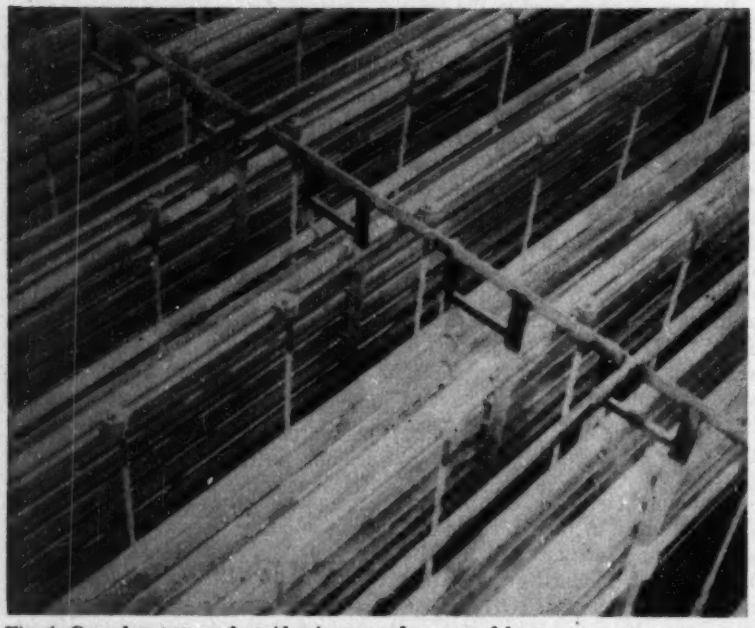


Fig. 4—Open box type cooler. Aluminum anodes are used here.

from d.c. equipment is illustrated by a midwestern paperboard plant in which the positive is grounded. Failure of some of the buried cable (positive) resulted in flow of current into the earth from the more distant building structures. Significance of the resulting damage by the flow of current into the earth upon the building foundation and piping is evident. This problem was resolved by an electrolysis survey which provided recommendations for correcting d.c. system operation.

In view of the complex inter-relationship of the physical and the electrical elements involved in buried pipeline corrosion the best corrective measures can be established by a thorough survey.

Protection of buried tanks and tank bottoms is usually accomplished by insulating the tank from foreign piping and applying protective current from magnesium anodes or graphite anodes with an impressed current potential.

RADIANT HEATING

The heating of industrial plants, homes, and garages by means of pipe embedded in the concrete floor, through which hot water is circulated, has in some instances resulted in the external corrosion shown in Fig. 1. The condition illustrated occurred on the underside of a pipe laid directly on soft shale. Similar attack has been observed on pipe laid on porous concrete. This problem can be overcome by completely surrounding the pipe with dense concrete and keeping it dry by suitable crushed stone and waterproof construction.

Cathodic protection is being used to protect radiant heating systems where serious corrosion has occurred. This is done by applying a protective current flow from magnesium anodes or rectifiers and graphite anodes buried beneath the floor slab as required to best treat the specific problem. A protective current density of 0.35 ma. per sq. ft. has polarized a properly constructed heating system to a potential assuring full protection. An over-all current density of over 10 ma. per sq. ft. is required to prevent further attack in the instance shown in Fig. 1. In order to limit the metal areas being protected the radiant heating piping is insulated from all other piping by insulating flanges or couplings.

CLARIFICATION EQUIPMENT

Cathodic protection is well adapted for corrosion control on the submerged surfaces of clarification equipment such as that shown in Fig. 3.

In one instance, at a water softening plant in the midwest, cathodic protection was applied to four clarifier equipment installations at ¼ of the $45,000 cost of cleaning and coating such surfaces in 1948. Severe pitting at the breaks in the original coating was brought under control by a protective current flow of less than 12 amp. on each clarifier. Recognition must be given to the effect of the remaining original coating in keeping the protective current requirements at a low value.

Cathodic protection is applied to

clarifiers such as that shown in Fig. 3 used for water softening, pulp mill white water clarification, and in the treatment of oil field brine.

CONDENSER AND HEAT EXCHANGER WATER BOXES

In Fig. 4 the aluminum anodes used for the protection of a midwestern oil refinery open box type cooler are shown after one year's operation. The rectifier and fittings are explosion proof. A total area including tank, baffles and tubes of about 4,500 sq. ft. were fully protected by 20 amp. of protective current. An annual repair cost of over $3,000 was nearly eliminated by the application of cathodic protection. In sea water similar coolers are often protected by means of magnesium anodes.

Magnesium anodes are used in water boxes of condensers and heat exchangers to prevent corrosion and graphitization particularly where salt water is used for cooling.

MARINE APPLICATIONS

Protection of sheet and H piling of docks is an illustration of the application of cathodic protection to structures which are not readily accessible for repair or cannot be treated economically by other methods of corrosion control. A 150 amp. rectifier and graphite anodes are used for the protection of the sludge loading dock shown in Fig. 5. Magnesium anodes are used in the earth fill between the sheet piling and bulkheads to protect the sludge pipe.

Magnesium anodes are finding an effective application in tanks of ships used for both ballast and cargo. In Fig. 6 the removal of all rust scale and the deposition of calcareous salts is shown. Of particular interest is the evidence of so-called "throwing power" observed by the effect in the remote corners of the tank and over the surface of the heating coils. Such a favorable distribution of protective effect on a bare surface will occur only in highly conductive electrolytes such as sea water. These tanks can be used for carrying certain vegetable or animal oils after wire brushing any loose white deposit and leaching any soluble alkali with fresh water.

TANKS

Cathodic protection is widely used in sprinkler and general service water storage tanks, brine storage tanks, and hot water generating tanks. Each application must be considered separately to establish the best design and selection of materials. In northern areas, where ice forms in some tanks, the use of aluminum anodes (17-ST) is most practical. A new set of aluminum anodes is installed as soon as the ice has melted. Sufficient anode material is used to be consumed during the "corroding season" so that the ice forming the next winter will not damage the anode suspension. Corrosion rate is negligible when ice is in the tank.

Cathodic protection has been effectively applied to a lime-soda solution tank, used to treat water in a hot process softener, to which 1 lb. of chlorinated lime for every 30 gal. of solution had been added. Within

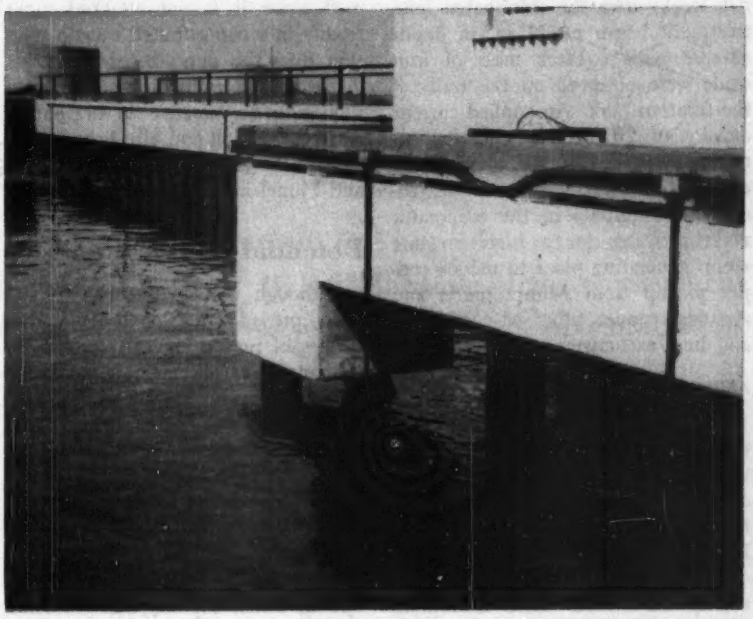


Fig. 5—This loading dock is protected with 150-amp. rectifier, graphite anodes.

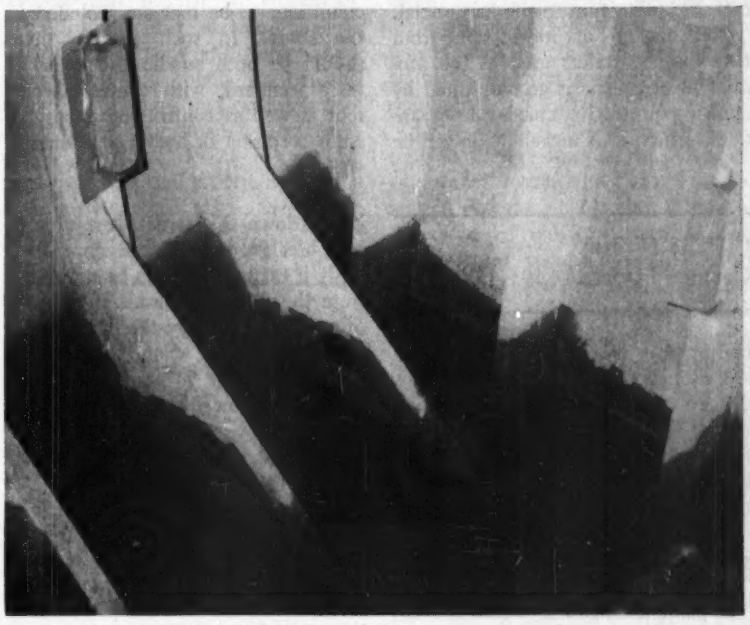


Fig. 6—Magnesium anode protecting ship tank.

two weeks after the chlorinated lime treatment began pits ⅛ in. in depth covered with a black mass of iron oxide were observed on the walls of the solution tank. An applied current density of 20 ma. per sq. ft. was needed to prevent further attack. The chlorinated lime was used to oxidize the ammonia in the evaporator makeup water for a high pressure steam generating plant to reduce copper pickup from Muntz metal and arsenical copper tubes of condensers and heat exchangers.

ALUMINUM AND NICKEL

Zinc coupled to aluminum is being used to protect the waterside of aluminum heat exchangers, jacketed tanks, and other equipment. Since aluminum is amphoteric, special care must be taken not to apply an excessive current flow to produce alkali which attacks aluminum.[4] Clad aluminum, by having a surface layer more anodic than the base metal, in effect applies cathodic protection to the base metal.

The pickup of nickel ion from nickel concentrators used in the production of caustic is accomplished by applying protective current from anodes of nickel. A nickel anode can be used since it is not attacked more readily in a concentrated caustic solution than the unprotected metal.[11]

Cathodic protection has been shown to be effective in preventing crevice corrosion and pitting on nickel, Types 302 and 316 stainless steel, and Monel in sea water.[8]

Potential Applications

Although cathodic protection has been proved capable in laboratory studies of preventing or retarding intergranular attack on iron[6] and aluminum,[1] season cracking of brass,[3] and corrosion of iron by concentrated caustic[6] and by stronger acid solutions,[8] practical application has only been slightly touched. Full scale test installations for studies are limited by cost and risk.

Best plan of attack appears to be one in which experimental corrosion test units are installed within the operating equipment so that all possible conditions to be met are included in the study. In such studies, there should be both anodic and cathodic test specimens, with controlled current as well as control specimens. If stress corrosion or hydrogen blistering is involved, stressed specimens similar to those used by Schroeder and Berk[7] would be helpful in evaluating the problem. In structures having several zones of characteristic activity, corrosion test units should be installed in each zone with provision made to measure potentials and current flow between the specimens in the zones during stages of operation. Such a study may be helpful in establishing the stage of the operation during which the most severe corrosion occurs.

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HOPPER DESIGN

Continued from page 195

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eral forces. A succession of force triangles may be drawn for the wedges above various trial planes as was done in Fig. 3a. Obviously there is one case for which thrust against the wall will be a maximum. Coulomb stated that the actual thrust against a wall is the maximum value as determined above, and this wedge of material is termed "The Wedge of Maximum Thrust". The plane is called the "Plane of Rupture". Strictly speaking it is not a plane but has a slight convexity upward, or downward, according to whether the material is granular or non-granular. Note that this plane is always well above the natural angle of repose for the material in question.

Leygue experimented with small movable retaining walls holding back visibly stratified granular material between glass sides. He established the fact that when the wall was tilted or moved (Fig. 4) the material behind it slid down this same plane of rupture, breaking the visible strata. Obviously if material were to be drawn off from the foot of the wall, movement of material above would again be by sliding down the plane of rupture. This is the case in storage hoppers.

With a storage hopper, especially when it is cylindrical, the surface of rupture is strictly speaking not a plane. However we are entitled to take a cross-sectional slice of infinitesimal thickness for analysis. In that case the surface of rupture can be considered as plane.

NON-GRANULAR MATERIAL

This rather extensive discussion is intended to show that, when handling difficult materials, the design of bins should have arching of the material as the main consideration. The least slope of a hoppered bottom should be such that the valley angles are definitely self-cleaning. It is somewhat preferable that no side should be very steep (except for a batch hopper); of course, there is no point in having a straight side.

The most desirable feature of design is to have an outlet that is large, in proportion to the difficulty expected in handling the particular material. Offset against this, though, is the fact that the discharge gate may be too hard to operate, if it is too large. The only desirable feature I see in a straight side for a hopper is that a "poking pocket" can be installed above the gate as in Fig. 5a to aid in getting flow started. Such a poking pocket can be a real help. With more difficult materials, it can be enlarged to include the entire bottom of the hopper. It is then an "expansion-hopper," as in Fig. 5b. In either case a dust-sealed cover, Fig. 5c, is of value.

When a really dependable flow is required, the outlet can be larger still and a mechanical feeder installed to regulate the flow. (Mechanical arch breakers can also be used. See *Chem. Eng.*, Nov. 1952, pp. 163-178.—*Ed.*) It must be realized that certain materials, such as wood chips, require either expensive design or somewhat costly handling. In general, however, some compromise can be worked out.

Heat Exchanger Costs Today

Here you will find not only unit costs but also factors influencing selection of type. By combined use of the physical data tables with the cost curves you get a comprehensive evaluation.

FRANK L. RUBIN

NOTE:—This article is the first of a series on heat exchanger costs. Coming: Further information on shell and tube exchangers which will include the effect on cost of increasing design temperature and pressure.—EDITOR.

UNFIRED heat transfer equipment exists in a wide variety of designs. For almost any service, several different designs may be used. In evaluating these one may consider initial cost, installation cost, size, weight, maintenance charges, probabilities for leakage, replacement part costs, expected life of equipment and applicability to other services.

Basis For Evaluation

Initial Cost—The prices given in this article were those in effect in February 1953 unless otherwise noted. Variations from this date are due to the physical impossibility of collecting such data from numerous sources simultaneously. To make costs current at any particular time the reader is advised to adjust our costs using equipment indexes such as the Marshall & Stevens Indexes in *Chemical Engineering*.

Many manufacturers have contributed to the data herein presented. Every attempt was made to keep the costs on a directly comparable basis. For a variety of reasons this could not always be done. For instance, Pyrex cascade coolers require hangers which are not furnished by the manufacturer; standard impervious graphite cascade coolers do not require such hangers.

Directly competitive units do not always sell for the same price. Reputable manufacturers, who furnish process and mechanical guarantees, often carry higher overhead charges than competitors, who do not furnish such guarantees. Shop facilities and procedures vary so that certain manufacturers may be directly competitive for a particular design in a given range of sizes and materials; outside of this range their costs may not be comparable.

Remember these facts:

1. **Costs are manufacturers' selling prices for February 1953, unless otherwise noted.**
2. **Installation costs are not included, unless so noted.**
3. **To adjust costs to date of estimate, use equipment cost indexes.**

Two exchangers with identical surfaces will not necessarily produce the same amount of heat transfer in a given service. Internal design features are of vital importance. Not all fabricators have the engineering experience and industrial know how to produce maximum heat transfer.

Exchanger selling prices are determined by costs of materials, fabricating charges, and manufacturer's overhead. Prices are not a function of the service of the heat exchanger but rather are based upon type of construction.

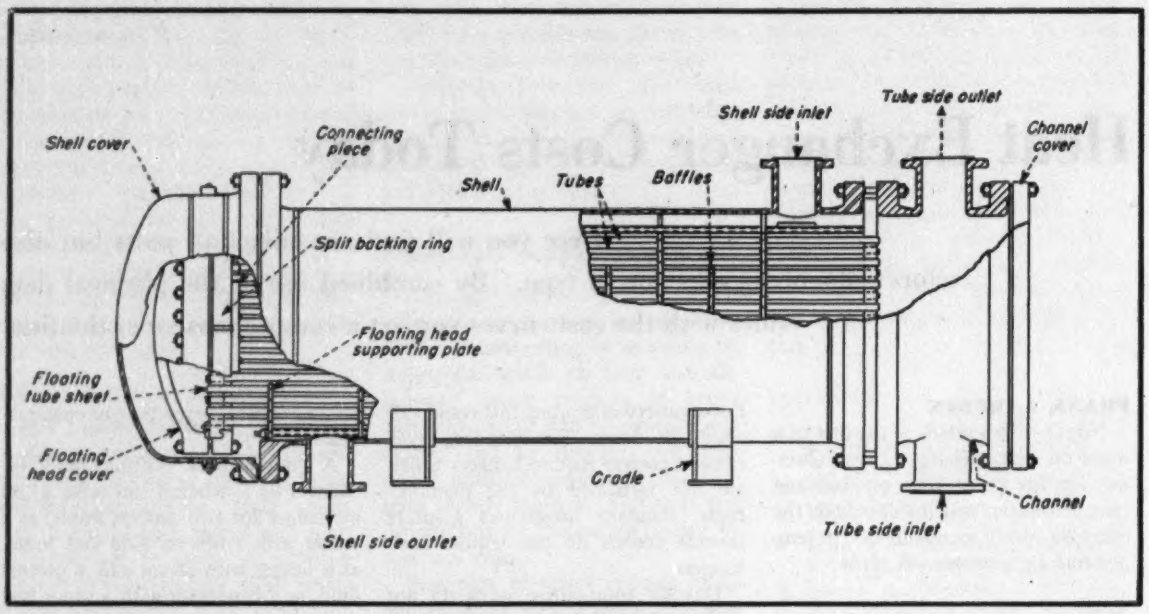
A conventional floating head exchanger as illustrated can serve as an exchanger for two process fluids, as a cooler with a process fluid and water, as a heater with steam and a process fluid, as a condenser with a vapor and water, or as thermosyphon reboiler with a process fluid and a heating medium. Nozzle positions, number and arrangement of baffles and tube side passes, and direction of flow would be varied to meet specific service requirements.

Every attempt has been made to limit exchanger costs to the realm of equipment commonly sold. For example, fin-tube double-pipe elements are discussed only for the standard lengths and most commonly used combination of inner tubes, fins, and outer tubes. Small exchanger costs are plotted on the basis of equipment sold—shorter tubes for smaller diameter exchangers.

Installation Costs—A shell and tube exchanger generally has the minimum installation cost since one need only connect piping to the two inlet and the two outlet nozzles and to bolt the cradles (or supports) to pedestals. Double pipe exchangers, cascade coolers, submerged sections, etc. usually must be installed section by section, and installation charges are often relatively high. Racks, collecting basins or steel tanks must be provided. Unless specifically mentioned, these installation costs are not included in this and other articles to appear in future issues.

Size and Weight—These are generally of little importance in the design of new plants. However, in existing plants available space and load bearing facilities may be limited. In mobile units, particularly aircraft, size and

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Design and Construction

SHELL AND TUBE split backing ring floating-head exchanger combines reliability with end-use flexibility.

weight are of major significance. Freight and installation charges are a function of weight and size; data are furnished for most designs discussed in this paper.

Maintenance Charges—If frequent cleaning is required the construction employed should facilitate cleaning. The same applies where maintenance is anticipated for corrosive or erosive reasons.

Where frequent cleaning is expected a channel (consisting of channel barrel with integral nozzles and separate channel cover) should be used. It is only necessary to remove the channel cover in order to examine or clean the tubes.

Where infrequent cleaning of the tube side of a shell and tube exchanger is encountered, the use of a bonnet (single piece tube-side header) is desirable. It is necessary to disconnect the tube side nozzles from the piping before removing the bonnet for inspection or maintenance of the tubes.

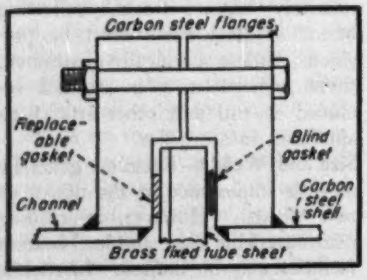
Some exchangers have both a channel and a bonnet. This combination can only exist where there is an odd number of tube-side passes.

The bonnet type of construction eliminates one joint and gasket; this reduces both cost and the possibilities of leakage. Where the shell side of the exchangers must be cleaned the more expensive pull-through type floating heat exchanger may be preherred to the conventional split ring floating-head design.

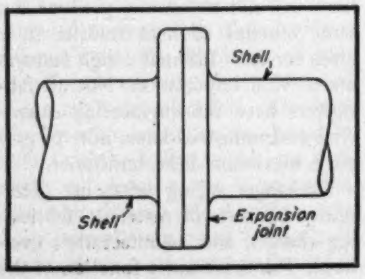
In both designs it is necessary to unbolt the channel from the shell flange at the stationary tube sheet before removing the bundle. The "pull-through" bundle may then be removed. The more conventional design requires that shell cover, split backing ring and floating-head cover be removed before the tube bundle can be removed.

Where chemical cleaning is possible, maintenance for cleaning purposes is relatively simple. Where mechanical cleaning of the shell side of the exchanger is necessary tubes arranged on square pitch with wide cleaning lanes are desirable to simplify the operation.

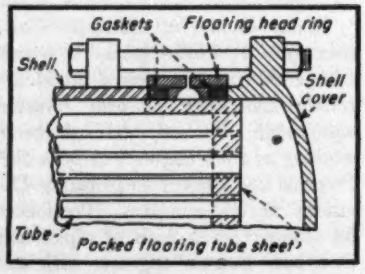
Leakage—Leakage should be considered. Where it is of little importance the packed floating-head design in low pressure service provides a relatively inexpensive type of removable bundle exchanger. Where it is undesirable the more expensive full floating head design may be used. (The welded, fixed-tube-sheet design has the least probability of leakage.) Where mixing of the two fluids must



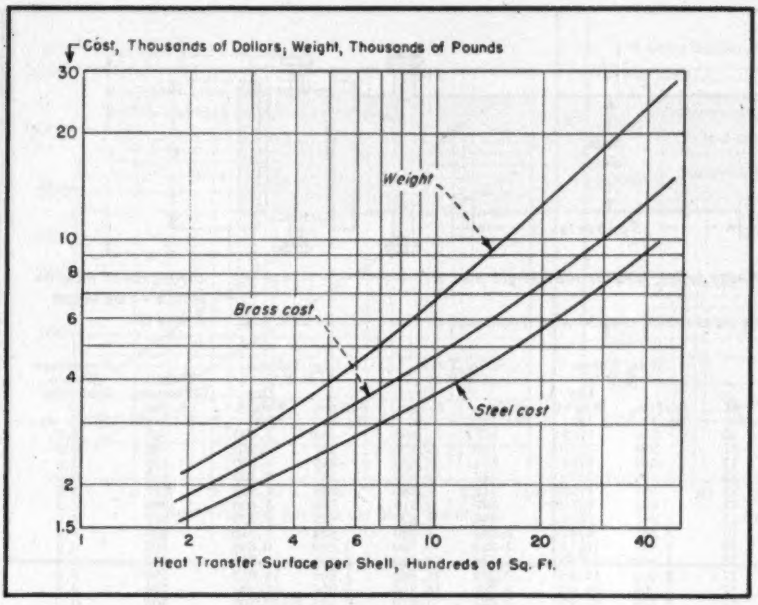
BLIND GASKET is not replaceable.



EXPANSION JOINT acts like spring.



PACKED HEAD allows bundle removal.



Costs

Material	Pitch, In.		Weight Factor	Cost Factor
150 Psi., Tubing ¾ In. O. D. x 16 Ft.				
Steel	15/16	△	1.00	1.00
Brass	15/16	△	1.03	1.00
Steel	1	□	1.12	1.12
Brass	1	□	1.16	1.12
300 Psi., Tubing ¾ In. O. D. x 16 Ft.				
Steel	15/16	△	1.15	1.15
Brass	15/16	△	1.22	1.15
Steel	1	□	1.32	(1.15)(1.12)
Brass	1	□	1.41	(1.15)(1.12)
150 Psi., Tubing ¾ In. O. D. x 20 Ft.				
Steel	15/16	△	—	0.90
Brass	15/16	△	—	0.95
150 Psi., Tubing 1 In. O. D. x 16 Ft.				
Steel	1¼	□	—	1.15
Brass	1¼	□	—	1.19

Note: Construction standards are TEMA., Class R.
Steel exchangers—all parts carbon steel, 14 B.W.G. tubes.
Brass exchangers—Admiralty tubes 16 B.W.G., NRB baffles and tube sheets, all other parts carbon steel.
B.W.G.—Birmingham wire gage for tube wall thickness.

Factors

COSTS AND FACTORS for conventional floating-head exchangers, either brass or steel construction.

absolutely be prevented, the expense of a double tube sheet with a leakage chamber between them may be justified.

Replacement Part Costs—U-tubes are special and cannot be put back in the bundle. Removable bundles can be replaced. Fixed-tube-sheet bundles cannot. Individual tubes can be removed and replaced.

Life of Equipment—Fixed tube sheet with blind gasket will leak eventually and cannot be repaired. Carbon steel with corrosion allowance may be more economical than certain alloys.

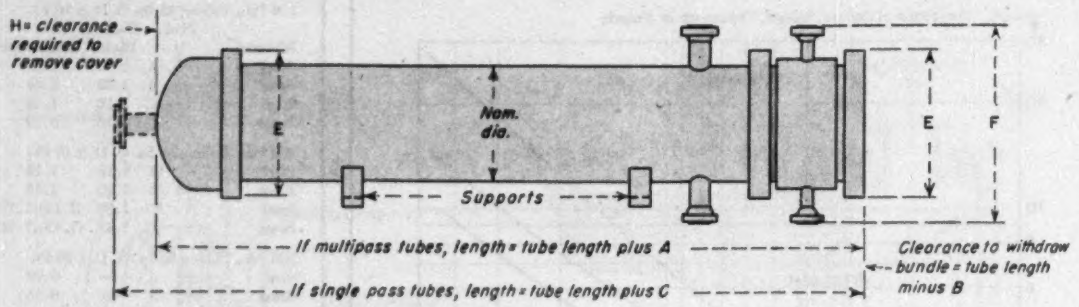
Other Services—If the equipment is likely to outlast the process, it is advantageous to be able to use the exchanger on other service. Multiple units, such as double-pipe exchangers or a series of small exchanger shells, can generally be put into other services more readily than a single larger unit.

Tube Sheet Layouts (Tube Counts), Triangular Pitch[1]

Nominal Shell Dia., In.	¾-In. O. D., 15/16-In. Pitch 1-P	2-P	4-P	6-P	¾-In. O. D., 1-In. Pitch 1-P	2-P	4-P	6-P	1-In. O. D., 1¼-In. Pitch 1-P	2-P	4-P	6-P	1¼-In. O. D., 1 5/16-In. Pitch 1-P	2-P	4-P	6-P
8	36	32	26	24	37	30	24	24	21	16	16	14	—	—	—	—
10	62	56	47	42	61	52	40	36	32	32	26	24	20	18	14	—
12	109	98	86	82	92	82	76	74	55	52	48	46	32	30	26	22
14	127	114	96	90	109	106	86	82	68	66	58	54	38	36	32	28
16	170	160	140	136	151	138	122	118	91	86	80	74	54	51	45	42
18	239	224	194	188	203	196	178	172	131	118	106	104	69	66	62	58
20	301	282	252	244	262	250	226	216	163	152	140	136	95	91	86	78
22	361	342	314	306	316	302	278	272	199	188	170	164	117	112	105	101
24	442	420	386	378	384	376	352	342	241	232	212	212	140	136	130	128
26	532	506	468	446	470	452	422	394	294	282	256	252	170	164	155	150
28	637	602	550	536	559	534	488	474	349	334	302	296	202	196	185	179
30	721	692	640	620	630	604	556	538	397	376	338	334	235	228	217	212
32	847	822	766	722	745	728	678	666	472	454	430	424	275	270	255	248
34	974	938	878	852	856	830	774	760	538	522	486	470	315	305	297	288
36	1102	1068	1004	988	970	938	882	864	608	592	562	546	357	348	335	327
38	1240	1200	1144	1104	1074	1044	1012	986	674	664	632	614	407	390	380	374
40	1377	1330	1258	1248	1206	1176	1128	1100	766	736	700	688	449	436	425	419

Square Pitch

Nominal Shell Dia., In.	¾-In. O. D., 1-In. Pitch 1-P	2-P	4-P	6-P	1-In. O. D., 1¼-In. Pitch 1-P	2-P	4-P	6-P	1¼-In. O. D., 1 5/16-In. Pitch 1-P	2-P	4-P	6-P	1½-In. O D., 1⅝-In. Pitch 1-P	2-P	4-P	6-P
8	32	26	20	20	21	16	14	—	—	—	—	—	—	—	—	—
10	52	52	40	36	32	32	26	24	16	12	10	—	—	—	—	—
12	81	76	68	68	48	45	40	38	30	24	22	16	16	16	12	12
14	97	90	82	76	61	56	52	48	32	30	30	22	22	22	16	16
16	137	124	116	108	81	76	68	68	44	40	37	35	29	29	28	24
18	177	166	158	150	112	112	96	90	56	53	51	48	39	39	34	32
20	224	220	204	192	138	132	128	122	78	73	71	64	50	48	45	43
22	277	270	246	240	177	166	158	152	96	90	86	82	62	60	57	54
24	341	324	308	302	213	208	192	184	127	112	106	102	78	74	70	66
26	413	394	370	356	260	252	238	226	140	135	127	123	94	90	86	84
28	481	460	432	420	300	288	278	268	166	160	151	146	112	108	102	98
30	553	526	480	468	341	326	300	294	193	188	178	174	131	127	120	116
32	657	640	600	580	406	398	380	368	226	220	209	202	151	146	141	138
34	749	718	688	676	465	460	432	420	258	252	244	238	176	170	164	160
36	845	824	780	766	522	518	488	484	293	287	275	268	202	196	188	182
38	934	914	886	866	596	574	562	544	334	322	311	304	224	220	217	210
40	1049	1024	982	968	665	644	624	612	370	362	348	342	252	2467	23	230



Nom. Shell Diam.	A	B	C	E	F	H	¾-In. Tubes, 16 B.W.G. Surface,	¾-In. Tubes, 16 B.W.G. Dry Weight,	¾-In. Tubes, 16 B.W.G. Surface,	¾-In. Tubes, 16 B.W.G. Dry Weight,	1-In. Tubes, 14 B.W.G. Surface,	1-In. Tubes, 14 B.W.G. Dry Weight,	Weight Difference, Lb. per Ft. of Length	Percentage Weight Deduction for 150-Lb. wp.
In.	In.	In.	In.	In.	In.	In.	Sq. Ft.	Lb.	Sq. Ft.	Lb.	Sq. Ft.	Lb.		
8	20	8	43	11⅞	24½	10	136	1,530	107	1,460	69	1,400	63	2.2
10	22	9	47	14⅛	26½	11	236	2,270	195	2,130	137	2,070	89	3.0
12	24	10	49	16½	29	11	366	3,010	314	2,890	223	2,800	124	3.6
14	24	10	50	17⅝	30¼	12	424	3,390	389	3,320	283	3,230	143	3.0
16	27	12	53	19⅝	33½	12	597	4,520	515	4,330	386	4,250	187	3.5
18	30	14	56	21⅞	36	13	801	5,740	697	5,510	523	5,400	229	4.2
20	30	14	57	23¾	37½	15	995	7,140	886	6,900	643	6,690	277	7.0
22	31	14	58	26	40	15	1,251	8,420	1,093	8,080	824	7,910	375	7.2
24	34	18	62	28½	43½	15	1,492	10,120	1,332	9,780	1,012	9,610	403	6.2
27	37	18	66	31⅝	46½	16	1,963	12,500	1,740	12,010	1,295	11,710	485	5.6
30	37	18	66	34¾	49½	17	2,502	15,460	2,224	14,860	1,699	14,610	590	7.6
33	39	19	68	38½	53	17	3,068	19,020	2,701	18,210	2,059	17,900	700	9.6
36	43	24	73	41¼	56	17	3,576	21,990	3,204	21,210	2,428	20,790	805	9.6
39	49	24	80	44⅝	58½	19	4,209	25,980	3,719	24,900	2,797	24,330	930	12.0
42	46	25	78	49⅛	62½	20	4,874	31,070	4,347	29,920	3,269	29,270	1,080	15.0
46	50	27	82	54¼	66½	22	5,937	38,160	5,339	36,910	4,015	36,110	1,270	17.0
50	55	32	87	58½	72½	23	7,120	46,230	6,370	44,630	4,856	43,890	1,500	18.0

Surface area—listed as sq. ft. for bare tubes 192 in. long, triangular pitch with two tube passes. Surface area of units with tube lengths other than 192 in. = (given surface/16) x desired tube length in feet.
Tube pitch—⅝ in. tubes, ¹³⁄₁₆ in. triangular pitch; ¾ in. tubes, ¹⁵⁄₁₆ in. triangular pitch; 1 in. tubes, 1¼ in. triangular pitch.
Dry weight—based on design for 300-lb. working pressure at 650 deg. F. with longitudinal baffle. For weights of units with tube length other than 192 in. add or deduct weight difference given above. Weight of exchanger full of water = dry weight x 1.40.

Dimensions and Weights

OUTLINE dimensions and weights for clamp-ring floating-head heat exchangers designed for 300 psi. pressure.

Shell and Tube Exchangers

Floating-Head Exchangers—In the conventional split-ring floating-head exchanger the floating end is completely free to "float" independently of the shell. A split-ring backing ring, connecting piece, and bolts hold the floating-head cover to the tube sheet.

The costs and weights of all-steel and of brass tube side, steel shell side floating-head exchangers are shown by the accompanying curves. Outline dimensions, weights, and surfaces for the clamp-ring, floating-head exchanger with tubes spaced on triangular pitch are also shown. These data differ only slightly from those for the conventional, backing-ring exchanger.

The cost curves represent average values of several manufacturers. It should be noted that competitors generally do not have costs which plot on parallel curves. Instead one finds that certain manufacturers can sell smaller exchangers for prices below the curves, while their larger units are more expensive. In turn their competitors can sell only larger units at lower prices, while the smaller ones are above average costs.

Construction standards and accounting practices differ. As a result the price differentials between 150-lb. and 300-lb. exchangers may be more or less than the average factor of 1.12.

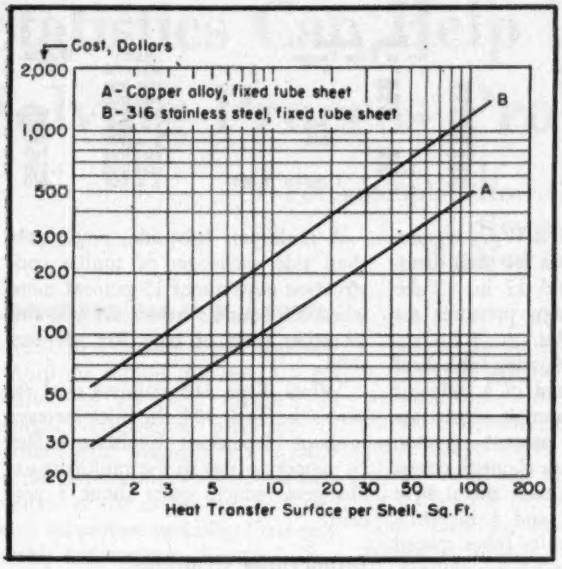
It is to be noted that these costs are for exchangers complying with the TEMA standards, class R. (Standards of the Tubular Exchanger Manufacturers' Association, 1952.) However, the requirements of certain companies for special items such as brass channels, extra corrosion allowance, etc. can readily increase costs ten, twenty, or thirty percent.

U-Tube Exchangers—The U-tube construction eliminates the floating tube sheet, floating-head cover and flanges at the shell cover. For exchangers designed for 300 psi. or less the cost is approximately ten percent below the floating-head exchanger cost.

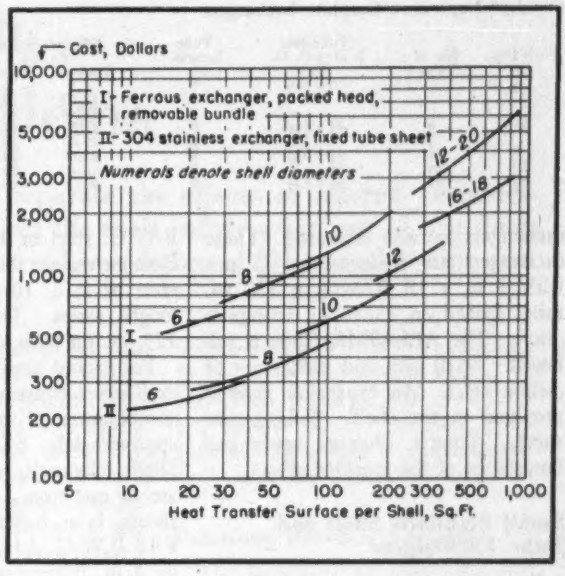
Fixed Tube Sheet Exchangers—Where possible the shell is welded to the tube sheets. When this is not feasible the tube sheets and shell are generally fixed in place with a blind gasket between them. In all designs both tube sheets are firmly fixed in place. For low pressures a simple expansion joint, as shown, may be used to permit tubes and shell to expand independently. Such units cost approximately twelve percent less than floating head exchangers.

Packed Head Exchangers—For low pressures this design provides the cheapest type of removable tube bundle. Costs are approximately ten to twelve percent below those for conventional floating-head exchangers.

Surface in an Exchanger—A given shell can contain more surface when tubes are spaced on triangular rather than square pitch. Smaller diameter tubes provide more surface in a given shell. Tube counts are given in the table. These are based on the split-ring floating-head exchanger. The tube count can be increased slightly for fixed tube sheet, or packed head construction. The pull-through floating-head exchanger provides less sur-



Costs



Costs

ECONOMICAL small standard shell and tube heat exchangers with design and construction noted on the curves.

face in a given shell. The U-tube exchanger contains approximately the same surface as does the split-backing-ring exchanger.

Using the Data–Assume that an all-steel floating-head exchanger is needed designed for 300 psi. on both sides with 2,000 sq. ft. of heat transfer surface. Four tube passes will be used with ¾ in. x 14 B.W.G. x 16 ft. tubing.

The number of tubes are calculated to be 2,000/(16 x ¾ x 3.14/12) = 637. From the tube count table for ¾ in. tubes arranged on 15/16 in. triangular pitch for four passes it is found that a 30 in. shell diameter will be needed for 640 tubes. This number of tubes equal 2,010 sq. ft. of surface.

Using the cost curve for floating head exchangers we find the cost to be $5,500 x 1.15 (factor for 300 psi. design) or $6,320. Weight from the same graph is 12,500 x 1.15 or 14,400 lb. The dimension table gives the over-all length of the unit as 192 plus 37 or 229 in. Distance over nozzles is 49½ in.

Comparative figures for a unit with 1 in. tubes, 20 ft. long can be determined in similar fashion. The number of tubes are calculated to be 2,000/(20 x 1 x 3.14/12) = 382. Referring to the tube count table under 1 in. tubes arranged on a square pitch we find that 380 tubes (1990 sq. ft.) require a 32 in. shell. The basic cost figure from the curve must be multiplied by factors for conversion from standard tube length (16 to 20 ft.), standard tube diameter and arrangement (¾ in. dia. 15/16 in. triangular pitch to 1 in. dia. 1¼ in. square pitch) and design pressure (150 to 300 psi.). Thus the adjusted cost will be $5,500 x 0.90 x 1.15 x 1.15 = $6,550.

Relative Costs of Alloy Floating-Head Exchangers, September 1952 prices.

Shell diameter, in.	12¾	36
Surface, sq. ft.	213	2430
Steel	1.00	1.00
80:20 Cupro-nickel	1.57	1.70
4–6 percent Chrome	1.90	2.11
Type 304 stainless steel	2.02	2.88
Type 316 stainless steel	2.56	4.05

In this case weight can be interpolated from the dimension table (for triangular pitch bundles) and the tube count table. Use the weights given for 30 and 33 in. shells and add an interpolated weight for the increased tube length.

Relative Dimensions and Costs of Alloy Fixed-Tube-Sheet Exchanger, Oct. 1952.

Dimensions			
O. D., in.	12¾	24	36
Surface, sq. ft.	250	950	2300
No. of tubes	136	486	1176
Baffle pitch, in.	6	12	18
Surface sq. ft.	250	950	2300
Costs			
Steel	1.00	1.00	1.00
Aluminum 3 S	1.25	1.13	1.13
Copper	1.46	1.46	1.58
Silicon bronzes (copper tubes)	1.51	1.56	1.64
70–30 Cupro-nickel	1.65	1.66	1.82
Type 304 stainless steel	1.82	2.01	2.21
Ampco 8	1.85	1.99	2.19
Type 347 stainless steel	1.99	2.21	2.47
Type 316 stainless steel	2.07	2.32	2.59
Monel	2.14	2.28	2.66
Nickel	2.26	2.41	2.85
Inconel	2.39	2.58	3.06

Thus 16,804 plus 2,656 equals 19,460 lb. which is applicable to 454 tubes in a 2 pass triangular pitch bundle. Since the square pitch bundle has 380 tubes the weight must be reduced by (454 – 380)(20)(0.813) or 1,160 lb. for a calculated weight of 18,300 lb. (Note 0.813 is the weight per lineal ft. of 1 in., 14, B.W.G. steel tubing.)

Over-all length will be 240 plus 39 or 279 in. Distance over nozzles will be 53 minus 1 or 52 in.

Alloy Exchangers–Additional costs for exchangers of metals other than carbon steel are dependent primarily upon extra costs of the materials and the additional labor and shop costs that may be required to fabricate these metals.

For conventional floating head exchangers relative costs are tabulated. These exchangers are designed for 150 psi. with ¾ in. O.D. x 16 B.W.G. x 192 in. tubes spaced on 1 in. square pitch. Steel tubes are 14 B.W.G.; alloy tubes are 16 B.W.G. The TEMA Standards and API-ASME Code are adhered to. Shell side is of carbon steel with ⅛ in. corrosion allowance. Steel baffles are spaced at 0.6 times shell diameter. Tubes, tube sheets, channel, and channel cover are of the specified alloy.

Based on prices of October 1952, the relative costs for fixed-tube-sheet

Standard Impervious Graphite Exchangers

Shell Dia., In.	No. of Tubes	Tube Size I. D. x O. D., In.	Tube Length, Ft.	Effective Surface, Sq. Ft. External	Internal	Price, Dollars No. of Tube Passes 1	2	3	5	Baffle Material	Weight, Lb.
6	7	1 x 1¼	3	7.5	5.0	410	480			cast iron	
			6	15.75	10.5	450	520			cast iron	
			9	24.0	16.0	520	590			cast iron	440
8	9	⅝ x 1¼	6	17.7	12.4	510		555		s. s. 302	280
			9	26.5	18.5	570		615		s. s. 302	350
8	14	¾ x 1¼	9	42.0	29.4	865	945			cast iron	700
10	24	¾ x 1¼	9	72.0	50.4	1,100	1,100			cast iron	1,150
10	31	¾ x 1¼	9	91.2	63.8	1,285		1,385	1,397	s. s. 302	870

exchangers are also tabulated. These exchangers are designed for 75 psi. with ¾ in x 18 B.W.G. x 120 in. tubes spaced on 15/16 in. triangular pitch. The API-ASME Code is followed. Shell side and baffles are of carbon steel. An expansion joint is provided in the shell. Tubes, tube sheets, channel, channel cover and bonnet are of the specified alloy.

Small Standard Shell and Tube Exchangers

Small, standardized shell and tube exchangers are furnished by several manufacturers. Economies are readily available when purchasing such units. Costs for several of these standardized types are shown by the curves.

Smaller Sizes—Curve "A" is for fixed tube sheet exchangers with shell diameters from 2 to 8 in. Tubes are ¾ in. O.D. and arranged on triangular pitch; forged bonnets are furnished. Tube sheets are an integral part of the shell hub forging which includes the shell pipe taps and supporting feet. All materials of construction are copper alloys.

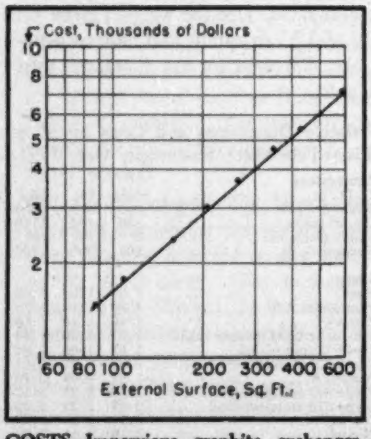
Design pressures are 75 psi. on both sides. For shell-side design pressure of 225 psi. and tube-side pressure of 150 psi., costs are about twenty percent higher. It is to be noted that there is no "blind" gasket. The more common fixed-tube-sheet exchanger with brass tube sheet and steel shell has a "blind" gasket between the shell flange and the tube sheet; eventually the gasket leaks and it cannot be replaced.

Curve "B" is for Type 316 stainless steel exchangers of cast construction identical with that described above except that design pressure is 225 psi. on shell side and 150 psi. for tube side.

Intermediate Sizes—Packed head, floating-tube-sheet exchanger costs are shown in curve series I. The tube bundles are removable. Channel and floating head are of cast iron. Tube sheets, shell and baffles are of steel. Tubes are ¾ in. O.D. of either 14 B.W.G. steel or 18 B.W.G. copper. Cost curves are shown for shell diameters of 6, 8, 10 and 12 in. Tube length varies. Design pressures are 125 psi. on both sides.

For packed head, floating-tube-sheet exchangers constructed of a different combination of materials, costs are approximately 35 percent greater. Shells, channels, and channel covers are of cast iron. Muntz metal tube sheets, brass baffles, and ¾ in. O.D. x 18 B.W.G. Admiralty tubes spaced on ¾ in. triangular pitch are utilized. Design pressure is 75 psi. on both sides. Shell diameters are 6, 8, 10 and 12 in. The extra charge for steel shells varies from about 15 percent for the smallest size to three percent for the largest size.

Fixed tube sheet exchanger costs for stainless steel type 304 are shown in curve series II. The shell and baffles are of carbon steel. All other parts are of type 304 stainless steel. Tubes are ¾ in. O.D. x 18 B.W.G.. Shell diameters are 6, 8, 10 and 12 in. and the cost curves are marked accordingly. Tube length varies. Design pressure is 75 psi. and there is only one shell side and one tube side pass. Tube sheet and shell are welded together and no blind (irreplaceable) gasket is used. An expansion joint on the shell side is used for tubes longer than 10 ft.



COSTS—Impervious graphite exchanger.

A multi-pass tube-side, single pass shell side exchanger of similar construction costs about 10 percent more when the bonnets are of cast iron and all other parts of type 304 stainless steel.

When Type 316 stainless steel replaces the Type 304, the price increase is about 15 percent. Replacing baffles by support plates in the multipass exchangers reduces costs about 8 percent.

Impervious Graphite Exchangers

A new line of standard, full floating-head exchangers is now available. Tubes, channels, floating head and tube sheets are of impervious graphite. Baffles, shell and shell cover are of carbon steel. Tubes are ¾ in. I.D. x 1¼ in. O.D. x 108 in. long. Shell diameters vary from 12 to 30 in. Costs are shown on the graph.

Individually designed exchangers of impervious graphite are generally more expensive. Another manufacturer utilizing a packed, floating-head exchanger cites this design to be some 35 percent more expensive when units are individually designed.

Small standard exchangers of impervious graphite are available. These packed, floating-head exchangers are designed for flow of the corrosive fluid in the tubes. Tubes, tube sheets, floating head and channel are of impervious graphite. Shells are of standard steel pipe. Details and costs for these units are tabulated.

Acknowledgments

The author wishes to thank the management of the Catalytic Construction Co. for their cooperation which made this article possible. Appreciation is also expressed to the many companies which contributed information contained on these pages. A full listing of cooperating companies will appear at the end of this series of articles.

REFERENCE

1. Kern, Donald Q., "Process Heat Transfer," McGraw-Hill, 1950, p. 841, 842.

Statistics Can Help in Solving Process Problems

For example: How to separate the effects of related variables. How to get the most information out of test data. How to avoid overdesign of plants and equipment.

P. FERENCZ and B. H. LLOYD

NOTE:—*In an article which appeared in April the authors discussed the application of statistical methods to chemical engineering problems in measurements, sampling and quality control. This month's article is a continuation of the earlier one, with emphasis on process variables, their relationship and control.*—EDITOR.

Distribution of Variables

Most factors allied with chemical production are continuous variables. Temperature, pressure, analytical results, yields, and so on can take any values within certain limits. When such values are observed under controlled conditions, that is, when their variations are caused only by elements of chance, then the values will be grouped around an average value, and the frequency of observations will decrease for increasing deviations from the average. The further restriction that deviations from the average value are equally likely in either direction leads to the theoretical normal distribution whose mathematical formulation is based on these postulates.

Formulas and tables for normal distribution are widely applied in statistical work on problems where the variables are continuous; as a matter of fact, many problems where the distributions are not normal can nonetheless be treated in that way, mainly because the practical implications are more valuable than adhering strictly to rigorous theory.

In our problems we may often assume normal distribution without much loss of accuracy; however, there are many cases where we have to check carefully whether that assumption is justified.

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Let us take the case where we filter a sludge of gypsum with an average moisture content of 50 percent. Our moisture determinations are equally likely to be above and below that average value, and the observed values are likely to fit into a normal distribution. However, when we use a centrifugal to remove the water from a coarse, crystalline salt like sodium nitrate and get a product with an average moisture of 3 percent, then we will more often find values lower than 3 percent, but these will deviate from the average value less than the values which are higher than 3 percent. The distribution of the observed values will be asymmetric in the latter case, because no values can occur below zero, while high values may occur over a large range.

We will meet such conditions in many similar cases. For instance, when we have an average yield of, say, 98 percent on some material we will find higher values more frequently than lower values, but the lower values will deviate more from the average.

In such cases, if we use the logarithms of the observed values our distribution approaches normality. In the example of the moisture content the logarithms of the observed moisture contents will be approximately normally distributed around the average value of log 0.03; in the example of the yield the logarithms of the losses (1.0–the observed yields) will be normally distributed around log 0.02.

Although continuous and especially normal distributions are most frequently encountered in our problems some other types of distributions are encountered as well. Often the specifications for a product are such that the batches we manufacture are either good or bad. The specification may call for passing a certain color test, or for a negative result of a specified test on the presence of some impurity. In such cases the variable, that is, the considered property, can have only two distinct values. Sampling problems will then lead to the binomial or Poisson distribution.[*]

Relations Between Variables

The nature of our operations and experiments is in most cases such that some gradually changing condition will cause a gradually changing effect. This applies, of course, only between certain limits, a slight change in the temperature may cause freezing, decomposition, or some other sudden and thorough alteration when a certain limit is exceeded.

Within the limits where the variations of cause and effect—we will call them independent and dependent variables, respectively—are continuous we want to know the functional relationship between those variables. How is the yield affected by changing temperature, concentration or pressure? Is the effect of changing temperature the same at low pressure as at high pressure?

The answers to such questions may be found by statistical evaluation of available data, that is, of observations made at the plant or in course of experiments. The statistical procedure is essentially an analytical one. In a chemical analysis we separate the different components by converting them into different phases; in statistical analysis we separate the effects as caused by each variable by way of mathematical operations.

The concept of independent and dependent variables is common in algebra. When using these expressions in statistics the definitions have to be somewhat modified. We have seen that every measurement is subject to errors and to the effects of uncontroll-

[*] See April, p. 226, for references.

able random variations. Thus when we consider two variables simultaneously, values of the dependent variable will depend not only on those of the independent variable but also on the effects of all uncontrolled factors and errors. The situation is the same as having three variables, the third representing the summarized effect of all errors and uncontrolled factors.

Let us consider an example:

In an ammonia oxidation plant for the manufacture of nitric acid all operating conditions but the daily production load and cooling water temperature are kept constant. It is known that in summer, when the cooling water is warm, the loss of nitrous oxides in the stack is relatively high, especially when operating at high loads. Therefore it is considered advisable to cool the water artificially in summer. The cost of the required installation appears to be justified only if there is a sufficiently high probability that the annual stack loss would be less than 0.3 percent of the burnt ammonia when keeping the cooling water temperature at, say, 5 deg. C. during the whole year.

The statistical problem is to calculate the probability of higher losses than 0.3 percent at 5-deg. cooling water temperature. We will use data on cooling water temperatures, loads and stack losses as recorded in the monthly reports for three consecutive years.

As the first step we can calculate the best fitting linear relation between loss and cooling water temperature, disregarding for the moment the effect of the load. Although higher temperatures will usually correspond to higher losses we will find many points not falling on the straight line fitting the trend. We must measure the variation of these points from the fitted line in order to determine the usefulness of the line in estimating the stack loss based on the cooling water temperature. In fact, the variation in the losses is separated into two components, one representing the effect of temperature, the other reflecting all remaining variation. The latter includes the effect of the load.

A more precise estimate of the stack loss can be obtained if we determine the load effect in addition to the temperature effect. This amounts to separating the load effect from the residual variation above.

However, this whole analysis can be carried out in one statistical operation known as multiple linear regression analysis. For any given load the stack loss may be estimated for any desired temperature from the multiple regression equation. It is a simple matter then to determine the advisability of installing refrigeration. The relative importance of the temperature and load effects on stack loss is found from correlation coefficients. We would decide which factor has the larger effect by finding the correlation of each factor with the stack loss.

We must also examine the possibility of a relationship between the load and cooling temperature effects. This is most important, as this interdependence could easily lead to a wrong conclusion if not measured. For example, the correlation coefficient relating cooling temperature and stack loss could easily be affected by the interdependence of load and temperature. Under these circumstances we calculate what is known as partial correlation coefficients. We learn whether the correlation coefficient for cooling water temperature and stack loss is influenced by load.

By carrying out these calculations we can readily find the maximum load at which the savings by reduced losses will still be sufficiently high. This problem is treated elaborately elsewhere.[3,4]

Problems of this type are very common in the chemical industry. Their solution by statistical methods is indicated in every case when a large number of observations are available in our reports on operations or can be made readily in the plant.

In plant operations as well as in experimental work we often have occasion to check whether some suspected relation can be assumed to exist, that is, to detect a correlation. In other places, especially in technical calculations, we often know from theory that two variables are correlated, but we generally do not know what deviations from the theoretical relation can be expected to occur under practical conditions.

Take the case where a vapor is absorbed by scrubbing it with a suitable liquid in a tower. Theory shows that the height of a transfer unit *HTU* depends linearly on the ratio of the flow rates of liquid and gas L/G multiplied by the slope of the equilibrium line m. In other words, *HTU* when plotted against mL/G should be a straight line.[2]

The starting point and the slope of that line have to be found experimentally. Such experiments will result in a number of points scattered more or less closely around a straight line. We can draw the best fitting straight line by applying the method of least squares.

But are we justified in using that line for designing a large-scale absorption tower without further investigation? As some points have been found to lie under that line there is certainly a definite probability that the *HTU* might be lower in our tower than shown by the best fitting, so-called regression line.

To draw the proper conclusions we have to allow for the expected residual variance and select the height of the absorption tower in a way that provides a sufficiently high probability for achieving the proposed performance.

When the independent variable is the current time, then we speak of the time trend of the dependent variable. Knowledge of the time trend is required in many different problems. Thus, when a new operation is started, a certain time will elapse before full production can be reached and yields and production costs are stabilized at the proper levels. During that time we have to check the regression line of our data in order to find out whether the trend shows sufficient improvement and decreasing residual variance around the regression line. Such statistical evaluation will be of great assistance to the sales department in scheduling shipments in advance.

Records of repair costs on large pieces of equipment such as engines and compressors will show a time trend; usually costs increase at higher lifetime. Knowledge of that time trend, in this case the partial correlation between age of equipment and cost of repair, would enable us to provide for replacement at the proper time.

Study of time trends is especially important in problems of sales forecasting. Forecasts are based on a regression line, as observed in the past, by extending that regression line into the future. We may find the best fitting regression line by testing our data against a linear, a quadratic, or

an exponential relation and choosing that which leads to the smallest residual variance. In some cases we would assume a particular type of relation on the basis of experience.

Where a market saturation point is likely to be reached we will fit our data with a growth curve. For instance, a manufacturer of fertilizers, when considering the fertilizer consumption of a certain territory, will set a potential limit which may be reached when the quantity of added nutrients becomes equal to the quantity removed by the crop. This assumption neglects the possibility of increasing the yield per acre, but it may be used under relatively stable conditions to estimate the stage of growth for the territory considered.

In such problems the use of the so-called Gompertz curve is very convenient. It is a simple matter to check how closely the observed data fit a Gompertz relation, and in case of a good fit it will be apparent either that the trend is still on the sharply rising branch or has reached the stage when the curve starts to become flat.

Design of Experiments

Experimental work differs from plant operations in the important aspect that tests can be made with independent variables selected at specified levels. For instance, we can make a number of tests at a temperature of 10 deg. C., others at 20 deg., 30 deg., and so on, instead of making observations at varying temperatures as they occur in operations.

The control of conditions in the experimental laboratory makes possible greater sensitivity of the test. With a considerably smaller and more stable residual or chance variation the effects of the independent variables are more readily uncovered. For these reasons it is almost always possible to learn more about the behavior of process variables in the laboratory than in the plant. Unfortunately, because of practical limitations in the plant it is not always possible to make the best use of laboratory data.

Suppose we are investigating a process for the manufacture of an insecticide prepared by reacting two raw materials in the presence of sulfuric acid. We are concerned chiefly with the yield on the more expensive raw material.

Let us say we are interested at first to find out whether we can use 93-percent acid or whether it is better to use oleum. We could choose a certain reaction temperature, say 60 deg., and keep the ingredients at that temperature for 2 hr. At these fixed conditions we will make two series of tests, one with 93 percent acid and the other with oleum. We may have six tests in each series. The average yields in the two series will generally differ. Should the resulting difference be very large or very small, then we will be able to draw a conclusion.

However, what should we consider as a sufficiently large or small difference, especially when results of the individual tests in each series differ among themselves considerably, or what should be the conclusion when the averages differ only moderately? Evidently our conclusion will depend entirely on the subjective opinion of the examiner and his confidence in the reliability of the experiments.

A technique known as analysis of variance obviates this difficulty. It will tell us to what extent the difference among the average yields is likely to be due to the effect of the strength of the acid and to what extent to any other uncontrolled cause.

Now let us assume that our experiments and their statistical evaluation have shown that oleum definitely gives a higher yield. Then we may proceed to investigate the effect of reaction temperature. We may make six tests each at, say, 60, 80, and 100 deg. by using oleum. Suppose we find the highest yield at 60 deg. Then we may make six tests again at 60 deg. using oleum and react for 2 and 4 hr. Suppose the result is that 2 hr. reaction time gives a higher yield. Then we might conclude that oleum, 60 deg. and 2 hr. reaction time are optimum.

This type of experimentation, the investigation of only one factor at a time, is called the classical approach in statistics; it has been widely used in many fields. In the chemical industry, however, our problems cannot be treated in this way.

A chemist will promptly realize that the use of oleum in our case might be advantageous at low temperature but it might lead to sulfonation or decomposition at high temperature, especially when more time is allowed for the reaction. Thus it might well be that when reacting at higher temperature 93 percent acid would lead to better yields than are obtained with oleum at low temperature.

In statistical language we speak of this as interaction. There is an interaction between acid strength and temperature. The effect of the strength of the acid depends on the temperature. The same applies to acid strength and duration of reaction. There are more complex interactions as well. For instance, in the case considered the change of the effect of the acid strength due to increased temperature might be enhanced by extending the duration of the reaction.

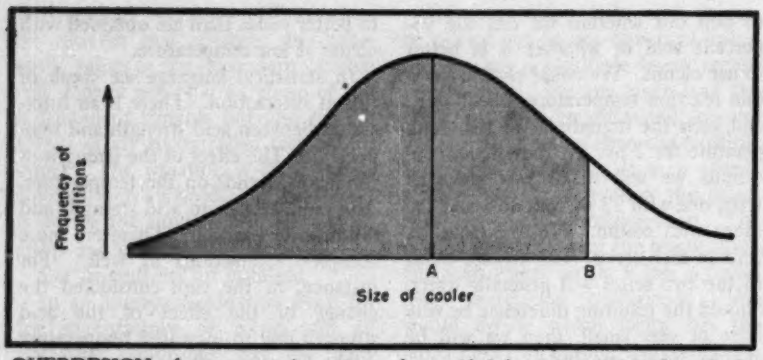
The existence of such interactions is the rule rather than the exception in our problems and, therefore, we do not perform experiments by way of the classical approach. In the case considered we will make twelve tests with two acid strengths, at three different temperature levels and at two reaction periods.

By applying the technique of analysis of variance we get an objective measure for the effects of independent variables involved. The analysis will also reveal which interactions are prevalent and what are their effects. In our case the presence of some interactions could be readily suspected. However, that is often not so, and the detection of any previously unsuspected interactions might become very valuable.

Analysis of variance will show us also to what extent the observed results are caused by factors other than the considered independent variables. If this residual variance is relatively large we might suspect that some other variable is present.

We can keep the number of our tests in experimentation at a minimum when we are familiar with the implications of the technique of analysis of variance. We mentioned before that six tests were considered necessary in order to get a reliable average in each series when testing the effect of one variable only. Statistical principles make it clear that less than six, say, four tests in each series would be sufficient in case of two variables, and generally, the necessary number of tests in each series, so-called replications, will decrease with increasing numbers of considered variables.

Often we can predict the absence of some interactions. This applies especially to more complex interactions. For instance, in the case of



OVERDESIGN of process equipment can be avoided by using statistical methods.

our insecticide an excess of the cheaper raw material introduced as a fourth independent variable probably would not interact with temperature or with duration of reaction. In such cases we can reduce the number of our experiments by using a pattern in which the testing on the insignificant interaction is combined with the effect of one of the independent variables or with the residual variance.

Ingenious methods have been worked out by statisticians, based on that principle, with the purpose of saving experimental work; for example, Latin squares.[10] Their application has proved to be very fruitful in fields where the cost of experiments is relatively large and other limiting factors have to be considered.

Engineering Design & Estimates

When we design equipment, our calculations will be based on data from the flowsheet, on physical constants of the materials involved and on the values of certain coefficients such as the heat-transfer coefficient, height of transfer unit, and so on.

Let us take the simple case of designing a cooler. Here we require data on the flow rate of the fluid to be cooled; we have to use values of physical constants of the cooled fluid and data on the temperature of the cooling water; we have to know the value of the heat-transfer coefficient, which depends on a number of factors, such as physical constants, fluid velocities, tube diameter and presence of dirt films. Some of those data will be known fairly accurately. Others, especially flow rates, cooling water temperature and heat-transfer coefficient, can only be estimated.

It was realized by Buckley[8] that the problem of design is essentially statistical because of the estimates involved. Usually we base our calculations on the highest expected flow rate, the highest value of the cooling water temperature, and use conservative values when estimating the heat-transfer coefficient. Having calculated the required surface of heat transfer in this way we modify our results by a safety factor to be sure that the wanted performance will be achieved under all possible conditions arising.

Evidently the effect of uncontrolled and random variations is very large in this case. We have to formulate the problem in terms of probabilities; we have to find the relation between the amount of heat-transfer surface and the probability of achieving the wanted performance. Based on that relation we can then calculate that size which is sufficiently large for a certain prescribed confidence limit. We may state the problem as what surface the cooler should have in order to be safe with, say, 99 percent confidence.

When designing the cooler in the usual way, we neglect the fact that the flow rate would not be the highest just at the time when the cooling water temperature reaches its highest value; in addition the heat-transfer coefficient may not be just the lowest because of large dust deposits before cleaning. Certainly these effects will even out to some extent in practice.

Their joint effect will depend on the most probable average values of the involved variables and on their potential fluctuations around that average (their standard deviation) and also on possible existing correlations. The cooler would have to be larger if the highest load is expected in summer, when the cooling water is warm, than if the opposite were true.

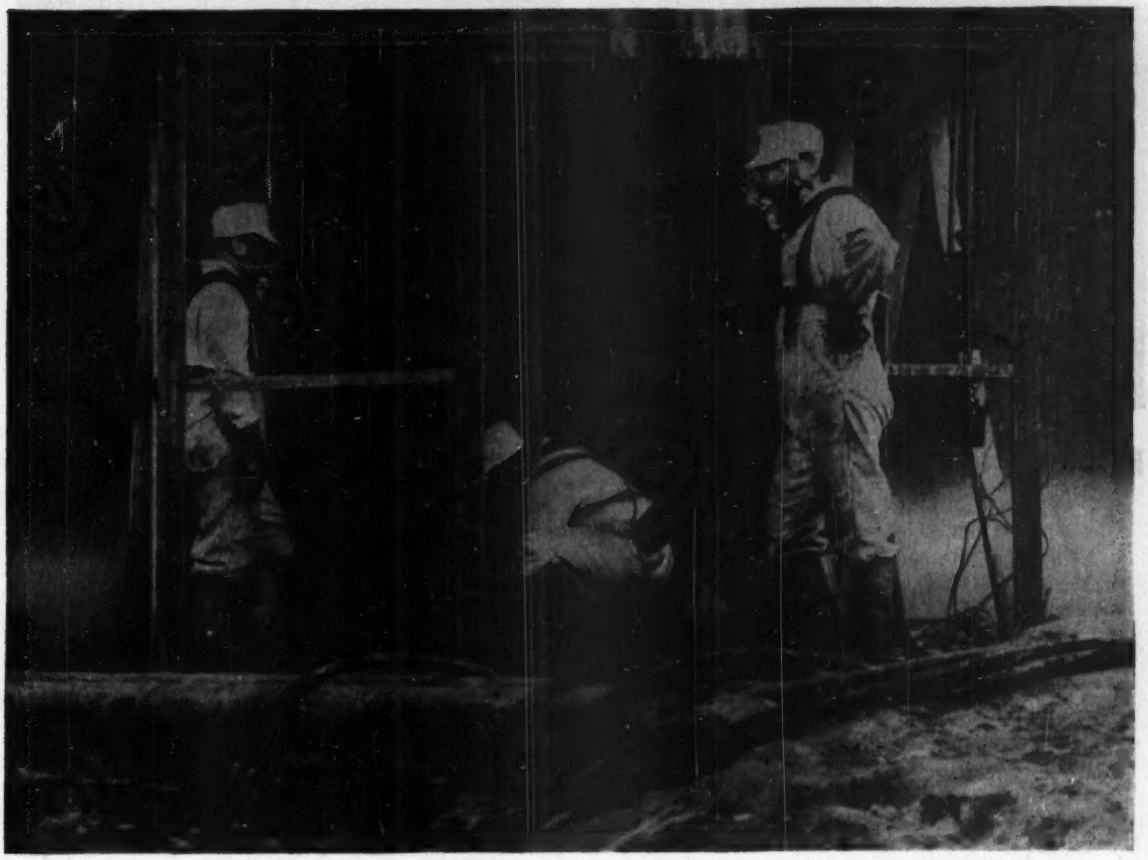
The method of procedure is to estimate, without any bias, the most probable average values; to calculate their standard deviations based either on observed values, as in the case of cooling water temperature, or on the limits between which the variable considered is likely to fluctuate. We then calculate the heat-transfer surface for average conditions and the standard deviation characterizing its expected fluctuations. The latter will be found by combining the standard deviations of the variables considered according to formulas applying for sums, differences, products, and other algebraic operations.

In most cases the distribution of the variables will be approximately normal. If this is so we may apply the normal probability curve when plotting the frequency of occurrence of conditions for a given cooler size against the size of the cooler (see *cut*).

The area to the left of each ordinate represents the probability that the selected cooler would be sufficiently large. That probability will be 50 percent for the average surface calculated, Point A. For any other selected size corresponding to Point B, the probability will be equal to the shaded area. Hence we have merely to look in a table of the normal probability integral to select a value B at which value of the heat-transfer surface the probability becomes sufficiently large, say, 95 or 99 percent. We will find that considerable savings can be achieved in many cases by sizing the equipment in this way instead of using the customary conservative methods.

Essentially the same idea, as applied by Buckley, led one of the authors[9] to treat cost estimates by statistical methods. By doing so we can take into account the accuracy of every individually estimated item and derive the standard deviation of the resulting figures on total costs, realization, profit and return on investment. Thus our estimate will show not only the most probable value of expected profit or return, but reveal also how those values may fluctuate.

These last examples should indicate that the use of statistical methods in the field of chemical engineering is by no means restricted to the problems usually treated in books on statistics. We have many special problems which do not occur in other fields.



Safety Is Your Business

You can prevent chemical accidents, but not by wishful thinking. Good safety records come only from energetic, well-planned safety programs. Here are the basic rules for a successful campaign.

JOSEPH GUELICH

Is the chemical industry a safe place to work? The records show that it is. In the National Safety Council's "Accident Facts, 1952 Edition," the chemical industry ranked ninth among forty major industries. But competition is stiff, and we've got some tough records to beat.

The 1951 accident frequency rate for all industries was 9.06 disabling injuries per million man-hours worked. The chemical industry's frequency of 5.48 was lower than those of such "safe" industries as textiles, storage and warehousing or even wholesale and retail trade.

Member firms of the Manufacturing Chemists' Association received 183 certificates of achievement in 1951 for operating the entire year without any accidents.

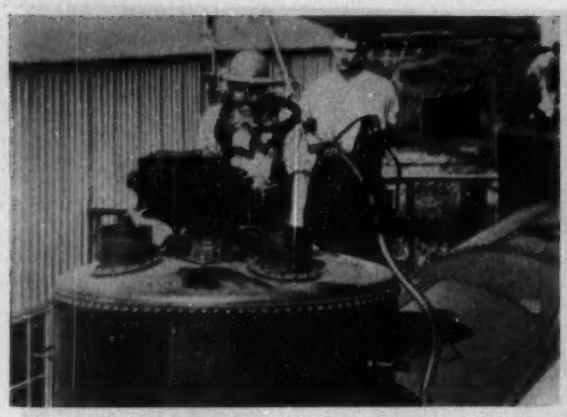
Shipbuilding, though, racked up a 4.81 record in an industry most people consider extremely hazardous. The steel industry beat us, too, at 4.50. These records were not just luck. They represent long-standing, smooth-working safety programs.

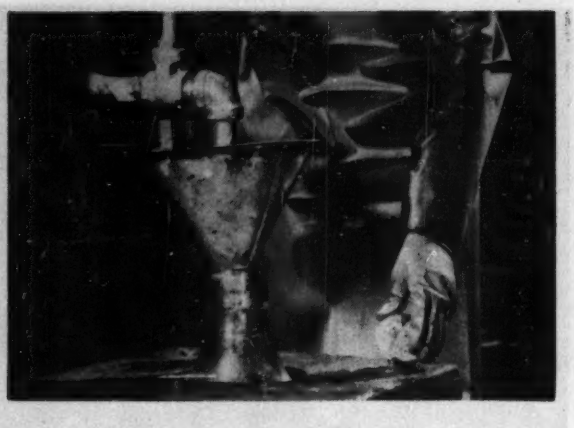
Unlike "general" accidents—backstrain, smashed fingers and falls—the prevention of chemical accidents requires the efforts of men trained not only in safety, but in fundamental chemical plant processes. Each plant must analyze its own special problems and then set about correcting them.

If a chemical company wants to achieve freedom from injury, it will measure its safety program by familiar yardsticks—support of management at all levels and cooperation by supervisors and workmen.

For the benefit of plants that need to augment their safety programs, here are some common chemical accidents and means for their prevention. Each type of accident could well be the subject of a month's intensive safety campaigning. *(Continued)*

JOSEPH GUELICH *is a chemical engineer and Supervisor of Safety, General Chemical Division, Allied Chemical and Dye Corp., New York, N. Y.*





Entering Tanks

Accidents in tanks are usually serious and often fatal. The same is true for other enclosed places such as hoppers, bins and sewers. Unlike open areas, the men are out of sight and their plight may go unnoticed for hours.

There are multiple hazards in entering a tank. The atmosphere inside may be toxic or there may be insufficient oxygen. Even if the air is initially safe, the work the men do may make it toxic.

Other mishaps result from not isolating the tank; that is, not ensuring that product and utility lines are effectively blanked or locked out.

Many tank accidents are compounded by the misplaced zeal of rescuers. The source of the first injury may be a hazard to all those who enter the tank in efforts to remove the injured man.

Tank accidents can be prevented by recognizing the dangers and by adopting this unvarying routine.

9 Rules for Entering Tanks

1. Write and publicize tank-entering rules.
2. Establish tank-entering permits. These should be certifications from the foreman, chemist and master mechanic that the tank is safe and that proper safety equipment has been provided.
3. Pull fuses and lock switch boxes. Blank product and service lines. Isolate tank completely.
4. Obtain air analyses from plant chemist including an appraisal of any dangerous fumes that might be liberated by the work to be done; e.g., CO_2 from acetylene welding.
5. Equip inside men with a safety harness secured—not merely held—outside the tank.
6. If a hazardous atmosphere is found or suspected, provide air flow within the tank. Also, equip the men with an air source: self-contained oxygen generator, air-fed mask or air-cylinder mask.
7. Leave tank ladders in place until work is completed. Provide ladder to top of tank for emergency crews.
8. Always have a safety observer outside the tank to watch the men working inside.
9. Most important, enforce your rules. Foremen intent on production sometimes hurry to put a spare tank in service. Teach them to observe safety rules regardless of the need for "shipment yesterday."

Dermatitis

Chemical dermatitis is seldom disabling, but it is more than just a nuisance. When it occurs the plant physician will probably advise you to change the man's job. This means you'll have to find that new job as well as the man's replacement.

Dermatitis is bad for morale, too. It is visible evidence to other workers that something is wrong. Laymen are inclined to fear that skin diseases are contagious, that it's unhealthy to eat near people suffering from what, to you, is simply a case of chlor-acne or defatting.

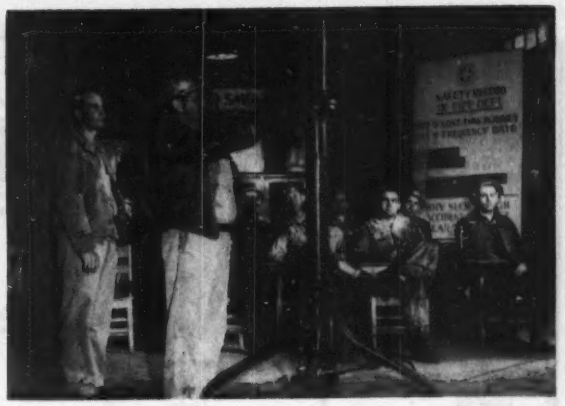
Once you have recognized any skin irritants present in your process, the prevention of dermatitis begins with a "tight" plant and strict hygiene.

Most men are agreeable to daily changes of clothes, but they often stop there. Resistance to the use of gloves, protective creams and daily baths must be broken down patiently. Here's a check list.

6 Rules for Preventing Dermatitis

1. Learn what substances in your plant are causing dermatitis or are capable of doing so. Change reagents, if possible. If not, tighten up the process. Isolate and ventilate it. Eliminate all possible manual operations. Try different concentrations or temperatures.
2. If your doctor tells you that workers with a certain type of skin are less prone to these diseases, do your best to hire that type.
3. Provide foremen with lockers containing gloves and protective creams. Consult your safety equipment supplier for the best creams to use.
4. Much dermatitis of the hands can be eliminated by installing a wash basin in the process room with adequate hot water, soap and towels. Encourage your men to use it frequently during lulls in their work.
5. Before you can demand daily showers, you must provide comfortable shower and change rooms with janitor service. At least two lockers per man are needed to prevent contamination of street clothes. Try a plant-operated laundry for work clothes.
6. Effective daily shower programs usually have to be supervised. Have the foreman or chief operator set an example by bathing with the men. Consideration should be given to allowing company time for showering.





Slow Poisoning

The subject of occupational disease is fully as complex as organic chemistry. Yet in the chemical industry the prevention of such afflictions can be effected by laymen.

Within the industry we may define an occupational disease as an illness resulting from repeated exposure to a harmful substance in quantities too large for the body to eliminate—slow poisoning.

The prevention of such disease is different from preventing accidents. You are not guarding against a sudden and unexpected occurrence; rather, you are seeking exposures which are cumulatively hazardous and which you hope to reduce rather than eliminate.

The approach to prevention is quantitative and scientific. First, identify the offending agents and estimate the amounts present. Then, if these quantities are over the permissible limits, take remedial action. Here's what you can do.

6 Rules for Preventing Slow Poisoning

1. Good reference books are a must. They will tell you what substances produce slow poisoning, the maximum concentrations allowed for an eight-hour shift, and what preventive measures can be taken.
2. Your plant physician can help by reporting suspected cases of an occupational origin.
3. Most quantitative appraisal will be by air-analysis. Results will tell you in a hurry whether preventive measures are needed.
4. Prevention is similar to that in dermatitis cases. A tight plant with good instrumentation, ventilation and dust collection seldom causes trouble.
5. Good hygiene is essential. Protective clothing will guard against repeated skin absorption. Respirators can be used in areas difficult to bring down to permissible limits. Daily showers and clean clothes reduce the danger and have the psychological effect of impressing on the men that the process must be treated with respect.
6. Your doctor can advise you whether clinical tests will aid in spotting slow poisoning. For example, parathion depresses the cholinesterase in the body; lead causes stippled blood cells; radiation produces eye changes. If such symptoms are caught early enough, correction can be made before any permanent harm is done.

Opening Lines

The one basic rule to follow when breaking lines is to treat every line as though it were full and under pressure. Even empty lines can spray, leak or drip for a number of reasons.

If the line is plugged, the physical act of breaking it may break the plug and release product. Or, the line may be under hydrogen pressure from slow corrosion of acid on metal.

And no line can be completely free of product. There are always bends, sags and valve cavities where product is entrained. Use this checklist.

5 Rules for Opening Lines

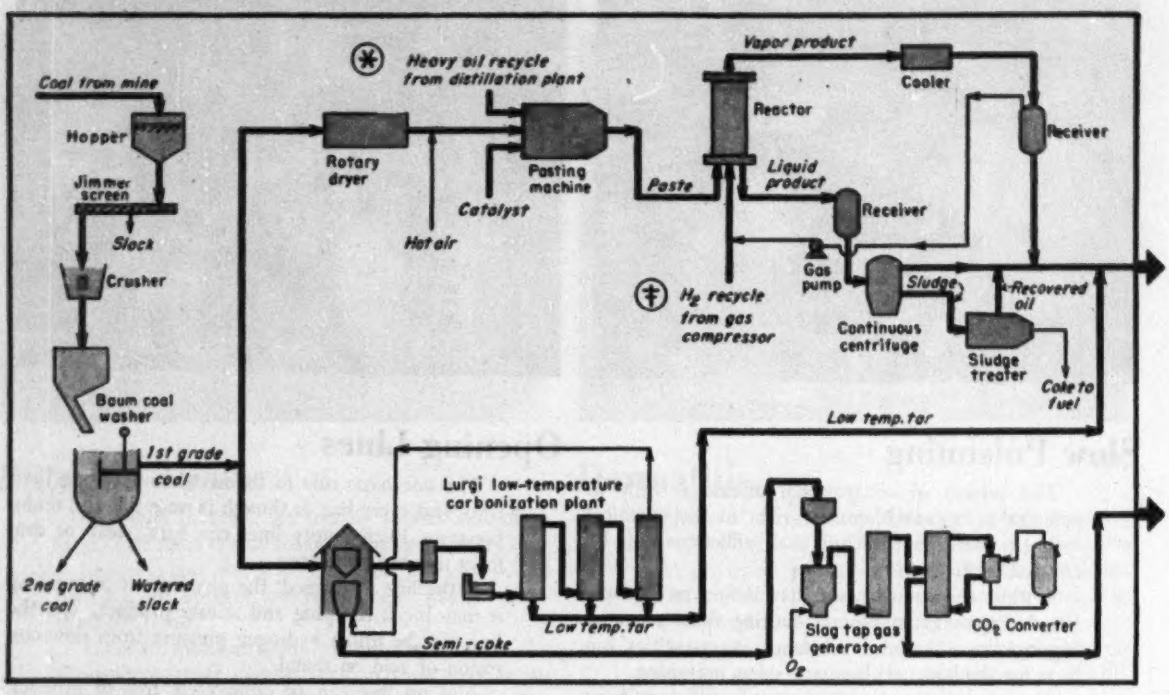
1. Write and publicize line-breaking rules.
2. Plan the job. Make sure everyone knows what is in the line and where emergency equipment is located.
3. Suit protective equipment to the abnormal. On really "hot" lines, this may include a portable shield, face shields, rubber clothes or air-fed masks.
4. Be sure to protect others in the area. Rope it off or evacuate it. Product can squirt a long way.
5. If the line is going to a shop, clean it thoroughly and let the shop foreman know what the contaminant is.

Reaction Heat

Unexpected heat or pressure caused by a reaction going too fast or by poor instrumentation result in many accidents in chemical plants. Here's a checklist to minimize this danger.

5 Rules for Reaction Heat Safety

1. In the transition from laboratory glassware and reagents to full-scale plant operations, watch reaction heats carefully. New reactions might take place.
2. Try to avoid manual operations which produce heat and which depend on the operator's judgment.
3. If manual operations are unavoidable, provide protective clothing and use instruments with audible alarms.
4. Your safety department can and should inspect for "cheated" instruments every so often. During the interim, make this the responsibility of the regular instrument men or mechanics.
5. When making process changes, work out calorie differentials in the laboratory before making plant runs.



Liquid-Phase Coal Hydrogenation . . .

Here's the first published report on a coal hydrogenation plant operated by the Japanese

KENZO SHIBATA

Faced with rapidly mounting military demands for petroleum products, Japan, in the mid 30's, was forced to look for synthetic processes to augment her small, static supply of crude oil. Probably the most outstanding of these efforts was the placing on stream in 1942 of one of the world's first commercial coal hydrogenation plants at Aoji, North Korea.

Utilizing high-pressure, high-temperature techniques similar to those now being used by Carbide & Carbon at Institute, W. Va., the plant was originally scheduled to produce 55,000 tons of gasoline, fuel oil and saturated hydrocarbons annually (about 1,100 barrels per day). In actual operation, however, the five sets of reactors proved to be capable of turning out 110,000 tons a year by treating 176,000 tons of moisture-free coal processed from low-grade lignite (8.8 percent ash).

The Japanese first began to study the Bergius process for coal liquefaction in 1920, but the many technical problems involved, financial difficulties and limited demand combined to delay for many years attempts at commercial installations.

In 1936, however, Japan Nitrogenous Fertilizer Co., Ltd. (Nippon Chisso Hiryo K.K.), with governmental blessing, decided to construct a commercial coal hydrogenation plant at Aoji on the northern frontier of Korea. Five years and $20 million later, the project was completed.

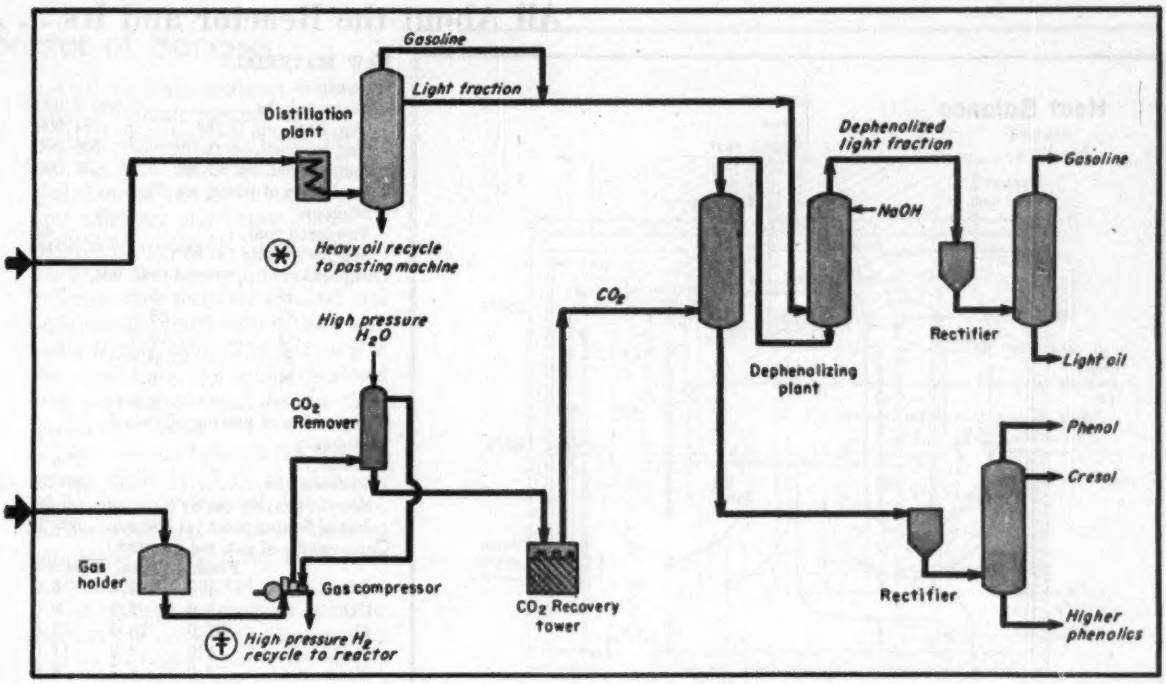
Nippon Chisso's ultimate aim was to use coal as a source of aromatic chemicals, and the techniques of coal liquefaction were the logical first step. The immediate need for synthetic gasoline dictated vapor-phase hydrogenation as the second.

Several major problems were involved. The engineering staff, specialized in ammonia synthesis and other similar processes, knew little about coal liquefaction. Brand new design concepts were needed in the reactors and related equipment, and time did not permit extensive pilot plant studies. Tests runs actually had to be run on full-plant scale, resulting in many expensive mistakes.

Despite these difficulties, the plant went on stream early in 1942. Five sets of reactors were designed for liquid-phase hydrogenation and they were operated at about 840 deg. F. and 3,200 psi. A unique sludge-treating device was installed and hydrogen was generated from coal by carbonization and slag-tapping methods, making the process practically self-contained.

Later in 1942, Nippon Chisso switched to maximum methanol production by converting the vapor-phase hydrogenation vessel to a methanol synthesis reactor. Production rates for this operation were almost 19,000 tons of methanol a year, over 65 percent of the entire Japanese production at that time.

KENZO SHIBATA was *Chief Engineer at the Aoji plant during its construction and operation. He is now Assistant Chief of the Research Dept., Shin Nippon Chisso Hiryo K.K., Tokyo.*



. . . The Japanese Were Using It in 1942

in North Korea during World War II to produce gasoline, methanol and phenolic oils.

Due to the iron-curtain policy in Russian-dominated North Korea, little is known about the operations of the Aoji installation following World War II. Latest U. S. Air Force information, however, indicates that the plant has been bombed out during the present Korean conflict and is no longer operating.

Different but Similar

Nippon Chisso's coal hydrogenation process differs from Carbide's present-day method in two major areas: final products and source of hydrogen.[ω]

Carbide's interest is primarily in aromatic chemicals, while the Japanese, due to government needs, concentrated first on gasoline and later on methanol. Also, Carbide is able to use byproduct hydrogen from nearby plants, but Nippon Chisso was forced to generate hydrogen from coal, not a very economical process.

In the main, though, the two processes are much alike. Three steps are involved: (1) prepare a coal-oil paste; (2) react it with hydrogen and catalyst at high temperatures and pressures; (3) separate the reaction products. Here's the Japanese method (see *flowsheet*).

Low-grade lignite from nearby mines is separated with Jimmer screens and Baum washers according to its use for hydrogenation, gas generation or fuel. First-grade coal for hydrogenation is dried, mixed with catalyst (mainly iron and sulfur) and heavy recycle oil from the distillation plant. It is then crushed and kneaded into a paste in a rotary pasting machine.[ω]

Coal for gas generation, also first-grade, is dry-distilled in a Lurgi low-temperature carbonization plant. The semi-coke from this operation is combined with oxygen in a slag tap gas generator at about 2,400 deg. F. to produce hydrogen.

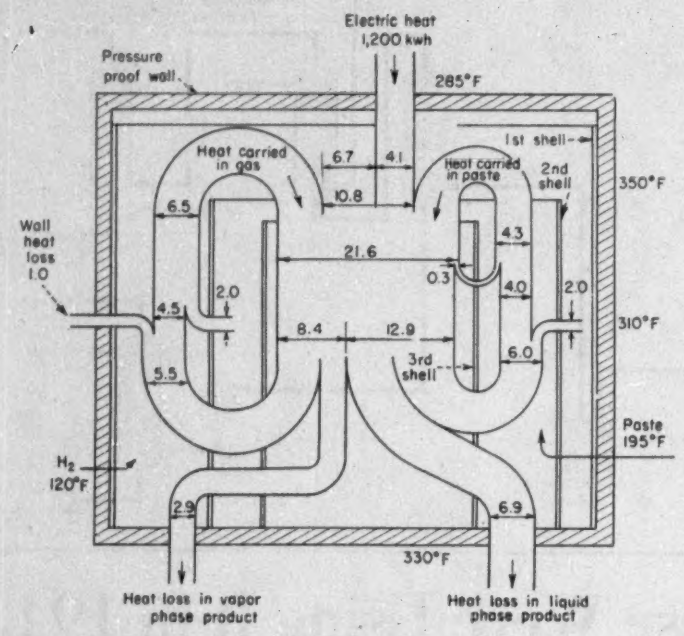
The inferior grades of coal, including watered slacks, are used to generate electric power by the use of back-pressure turbines.

Paste, hydrogen, reactor recycle gas and catalyst are then pressed into reactors which contain, besides a reaction zone, both an electric heater and heat exchangers. Separate liquid and vapor-phase products are obtained. The latter is condensed and passes directly to the distillation plant. The liquid phase is separated into oil and sludge by continuous centrifuging, with the oil going to fractionation and the sludge to a rotary sludge treater, where still more oil is recovered.

At the distillation unit, liquid products from the reactors, low-temperature tars from the Lurgi unit and oil from the sludge are collected and fractionated. The resulting gasoline and light oil streams are combined and dephenolized, and the heavy oil is recycled to the pasting machine.

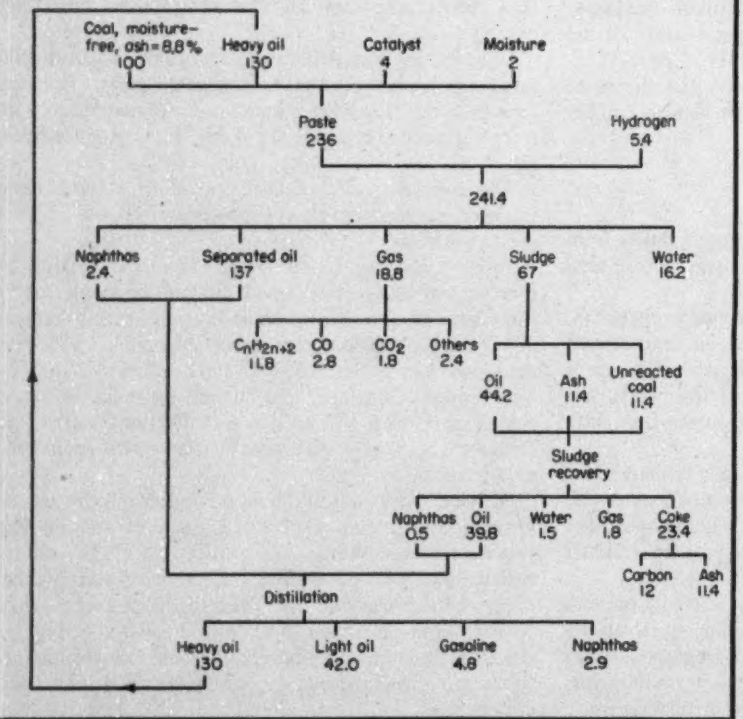
After dephenolization, the light oil can be used as feed stock for vapor-phase hydrogenation, and the gasoline goes to storage. Phenolic oils are further distilled into various end products.

Heat Balance



(Heat values expressed as million Btu)

Material Balance



RAW MATERIALS

Quantity

Paste, gal./hr.	2,650–2,900
Gas, fresh, cu. ft./hr.	194,000
Gas, recycled, cu. ft./hr.	530,000
Gas, purged, cu. ft./hr.	87,000

Composition of paste, wt. %

Moisture	1
Powdered coal	43
Specific gravity (at 90°C)	1.10

Composition of powdered coal, wt. %

H	5.2
C	68.5
O	16.0
S	0.4
N	1.1
Ash	8.8

Composition of pasting oil, wt. %

Moisture	0
Solids	0.3
Phenolic oils	20–22
Specific gravity (at 80°C)	0.93
Initial boiling point (at 760 mm)	590°F

Composition of gas, vol. percent

	Fresh	Total	Recycle
CO_2	4.0	4.4	5.0
CO	5.0	7.0	9.0
H_2	87.0	76.0	71.6
C_nH_{2n+2}	1.0	8.3	11.0
N_2	3.0	4.3	5.0
H_2S	trace	—	—
S	trace	—	—

TEMPERATURES, deg. F. (3,200 psi.)

Entering reactor

Paste	195
Gas	120

Inside reactor

Reaction zone	840
Gas, entering last heat coil	570
Cover	340
Liquid phase product	500
Vapor phase product	295

Outside reactor

Top surface	285
Side, upper	390
Side, middle	310
Bottom surface	220

ELECTRICITY FOR HEAT COIL

Current, amp.	4,600
Volts	330
Power, kw.	1,200
Power factor, percent	80

PRODUCTS

Quantity

Wt. balance: Paste 100 → Crude oil 88

Wt. ratio: Liquid/vapor = 73/27

Composition of crude oil, wt. %

	Liquid Phase	Vapor Phase
Moisture	1–2	0.5
Solids	15	0
Ash	7.5	0
Sp. gr.	1.03 (80°C)	0.90 (88°C)
Viscosity	41cp (80°C)	4cp (80°C)

Distillation of crude oil, wt. %

	Liquid Phase	Vapor Phase
Initial–390°F	0.4	2.0
390–480°F	2.2	6.5
480–610°F	17.0	33.0
610°F–	80.0	57.0
Phenolic oil, wt. %		
390–480°F	—	3.3
480–660°F	24.0	26.0

Secret of Success

The one really different feature of Nippon Chisso's reactor[69] is that the reaction chamber, electrical heaters and the heat exchangers are all included in one vessel. This gives better heat efficiency and closer control of reaction temperatures. Here's how it's built (see cut).

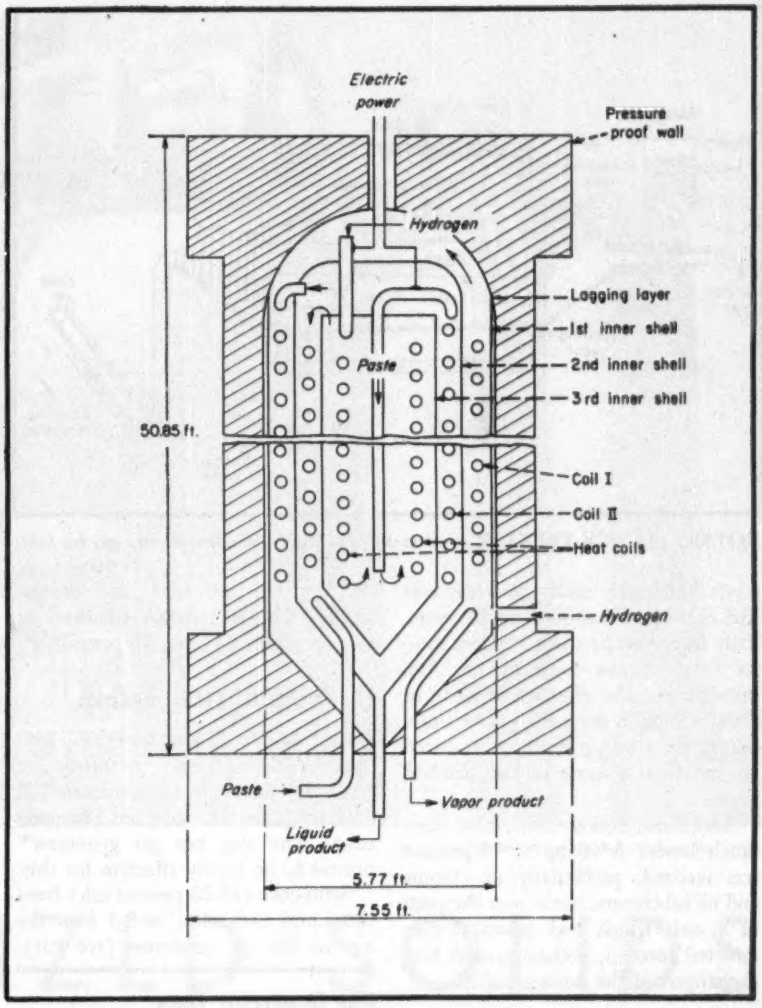
Three inner shells are installed in a high-pressure vessel with a thick wall and a lagging layer. The first shell is the vessel liner, the second is closed with a gas-tight cover, and the third has an open head.

Pipe coils run between the first and second shells (Coil I) and between the second and third (Coil II). Two hollow, steel heat coils are installed within the third shell and are used to conduct electric current.

The vapor-phase products from the reaction flow down Coil I and give up heat to hydrogen flowing up outside the coil. The preheated hydrogen then enters the top of the first heat coil, is heated to reaction temperature —840 deg. F.—and blows out the bottom of the coil into the reaction zone within the third shell.

Paste passes up Coil II and is preheated by the liquid-phase products flowing down the outside. Further heating occurs in the second heat coil and the paste emerges from the bottom to mix with the hydrogen. The reaction takes place as the two components move up the space within the third shell in contact with the outside of the heat coils and is finished by the time the mixture reaches the top. Pressures are normally about 3,200 psi.

Liquid products overflow the top of the third shell, flow down around Coil II, and leave at the bottom. The gaseous products are passed inside Coil I and also leave at the bottom.



REACTOR combines heating sources and reaction zone in one high-pressure vessel.

The Operating Story

The actual operations of the Nippon Chisso plant are detailed in the figures at left. Here's a summary of the data (based on 100 parts of moisture-free coal).

- Total unreacted coal was 11.4 parts, giving a reaction efficiency of 88.6 percent.
- Total oil leaving the reactor, assuming no degeneration of the 130 parts of heavy pasting oil, was 53.6 percent.
- Total recovered oil—after distillation—was 49.7 percent.
- The heat value of the coal-oil paste is 266.4 btu per lb.; that of pure coal is 792. The heat balance was calculated from these values and from the amount of electric power added. Since the total heat balance maintained in the reactor was five times the heating energy of the electricity, the heat efficiency was actually extremely good.

A second material balance was made during a very short run on a better grade of coal (3 percent ash). The reaction efficiency for this run was 95.8 percent, the total oil out of the reactor was 73.6 percent, and the total oil recovered after distillation was 72.6 percent.

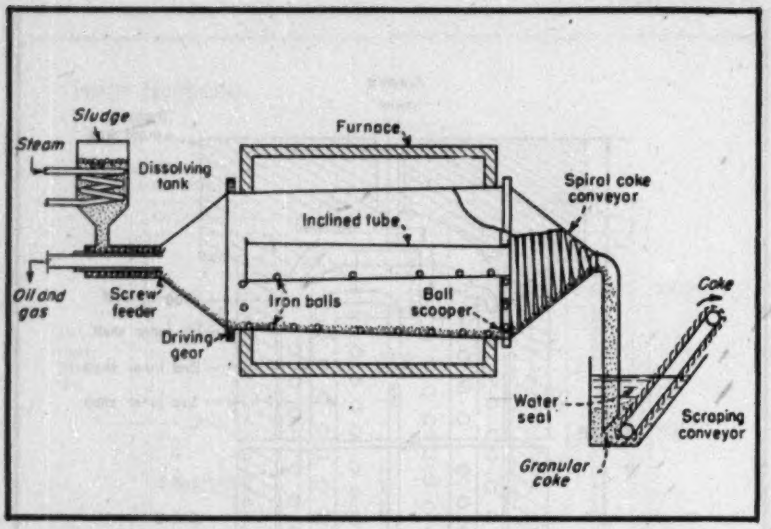
Another striking difference between the two runs was the amount of sludge formed—19 parts per 100 parts of coal in the second run as compared to 67 parts from the high-ash coal.

High Space Velocity

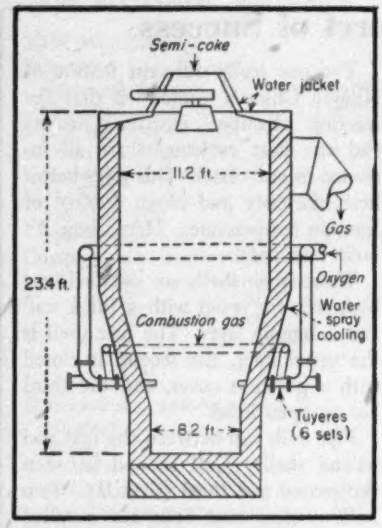
The ratio of the amou it of paste fed (2,650-2,900 gal. per hr.) to the total volume of the reaction zone (2,650 gal.) is defined as the space velocity. At Aoji, then, space velocities of 1.0-1.1 were obtained.

These are more than three times those reported in Germany (about 0.3) and more than four times those obtained in a Japanese reactor which did not incorporate the internal heating system. It follows, therefore, that the co-existence of internal heating and heat-exchange elements in the reactor did the trick.

In other words, the efficiency and



ROTARY SLUDGE TREATER recovers oil from sludge, yields coke and gas for fuel.



GAS GENERATOR—H_2 from coal.

control of highly exothermic reactions like coal hydrogenation can be materially improved by using reactors similar in design to those at the Aoji installation. The effective capacity of these reactors is more than three times that of the German-type vessels, based on the total volume of the reaction zone.

And construction costs, too, were much lower. A saving of 50 percent was realized, particularly in chrome and nickel-chrome steels, over the costs of a unit which had separately-constructed reactors, preheaters and heat exchangers of the same capacity.

Breaking the Sludge

One of the most difficult separation problems in coal liquefaction is recovering oil from sludge, particularly when a high-ash coal is the raw material. Many painstaking experiments and designs were tested at the Aoji plant before the engineers came up with the rotary sludge-treating device shown above.

The treater[4] consists of an inclined rotary cylindrical kiln set inside a furnace. A number of iron balls roll horizontally through an inclined pipe whose slope is opposite to that of the kiln.

Sludge is heated on the inside surface of the kiln and its oil is vaporized, leaving coke. The caked coke is continuously crushed by the iron balls as in a ball mill, and pulverized coke is withdrawn through a water seal. Oil vapors are removed through a pipe on the raw material inlet side of the treater. The oil recovery efficiency of this operation was over 90 percent.

Hydrogen Generation

Lacking a ready source of cheap tonnage hydrogen, it was necessary for Nippon Chisso to manufacture all their fresh reaction gas from low-grade coke. The slag tap gas generator[5] proved to be highly effective for this.

Semi-coke (26-28 percent ash) from the Lurgi carbonizer is fed into the top of the gas generator (see cut).

Gas Generator Data

RAW MATERIALS

Quantity
- Semi-coke, tons/hr.....4.51
- Limestone flux, tons/hr.....1.32
- Oxygen, cu. ft./hr.....45,900
- Combustion gas, cu. ft./hr.....105,950

Composition of Coke, wt. %
- Moisture.....15–17
- Volatile matter.....8–9
- Fixed carbon.....46–48
- Ash.....26–28
- Sulfur.....0.37–0.40

GAS PRODUCT

Quantity—230,000–247,000 cu. ft./hr.

Composition, vol. percent

CO_2	3–4
CO	69–73
H_2	18–22
C_nH_{2n+2}	1–2
N_2	2–3
S	trace

TEMPERATURES, deg. F.
- Combustion zone.....2,350–2,450
- Gas exit.....212–265

HEAT EFFICIENCY

$$\frac{\text{calories in gas product}}{\text{calories in coke + combustion gas}} = 88\%$$

Pure oxygen and combustion gas are blown into the bottom section through six water-cooled tuyeres to form the combustion zone. Burned gas is reduced in the hot coke layer above this zone, exchanges heat with the upper layer of raw coke and is withdrawn at the top of the unit.

The combustion gas is actually part of the recycle or waste gases from the hydrogenation reactor, and contains low molecular weight hydrocarbons. These are decomposed into carbon monoxide and hydrogen in the high-temperature combustion and reduction chambers.

AUTHOR'S NOTE

We have been informed that large scale experiments are being made on coal hydrogenation in the United States. We hope that this record of the Aoji plant will contribute to further developments in the field, furnishing information on a special reactor which is well-suited to this process. Further details are available in other reports.[6, 7, 8] The advice of Dr. Y. Oshima, an expert in fuel technology, was very valuable in the preparation of this report.

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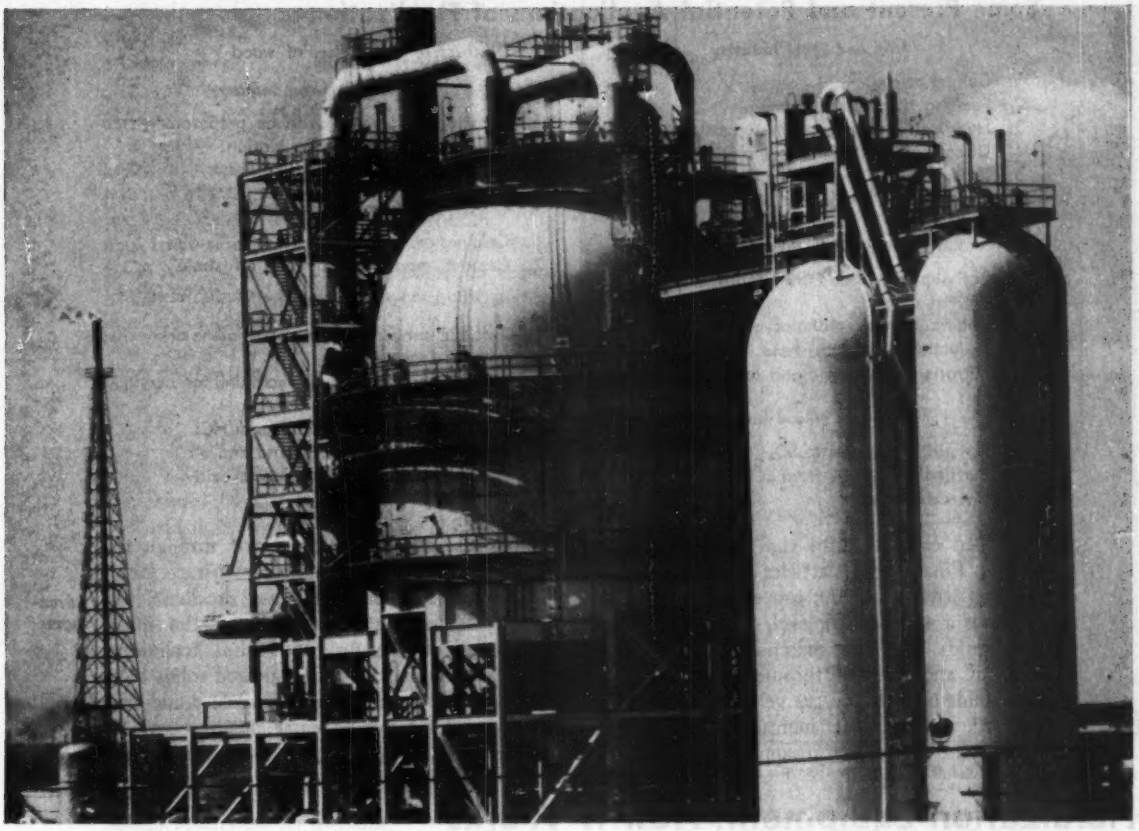


Photo courtesy of Standard Oil Co. of New Jersey

FLUIDIZED SOLIDS

War and aviation gasoline spawned the fluidized solids technique. Now recognized as a new unit operation it offers advantages in contacting gases with solids. Report gives a timely survey of fluidization know-how and application.

MARSHALL SITTIG

CHEMICAL ENGINEERING REPORT—MAY 1953

WHY should you be interested in solids fluidization? It has found application in the catalytic cracking of petroleum, but where does it fit into pulp and papermaking, steel manufacture, or the dyestuff industry? Some answers to these questions are shown in the table on the following page. As you can see, solids fluidization is already a unit operation of wide interest, ranking with crystallization, filtration and the others as a basic tool and—more important—as a means to the conduct of new and improved processes.

Broadly, fluidization offers a means of contracting gases with solids, just as do fixed and moving-bed processes. In fluidization, gas is introduced at a gradually increasing rate to the base of a vessel containing a powdered solid.

MARSHALL SITTIG is a chemical engineer with Ethyl Corp., New York. He has published several comprehensive articles on catalytic cracking including one on the evolution of the moving bed technique, Chemical Engineering, Dec. 1950, p. 106.

Some Present and Potential Applications of Fluidization

Iron and Steel Industry

1. Coking of coal
2. Feeding the blast furnace
3. Hydrocarbon synthesis in top of blast furnace
4. Direct reduction of metal oxides in fluid bed
5. Production of cheap oxygen for metallurgical operations

Dyestuff Industry

*1. Phthalic anhydride from naphthalene or xylene, for vat dyes
2. Chlorination of phthalocyanine pigments
3. Reduction of nitrobenzene to aniline
4. Nitration of benzene and toluene

Paper and Wood Industry

*1. Roasting of pyrites to SO_2
2. Purification of SO_2 from SO_3
3. Destructive distillation of wood

Non-Ferrous Metal Industry

*1. Roasting of arseno-pyrite as preparatory step for gold recovery by cyanidation.
*2. Roasting of copper and zinc ores

Cement Industry

*1. Calcination of limestone
2. Cement manufacture from oil shale

Plastic Industry

*1. Phthalic anhydride from naphthalene or xylene, for alkyd resins
2. HCN by cracking of formamide, for acrylonitrile and nylon
3. Vinyl chloride from C_2H_2 and HCl
*4. Ethylene oxide from ethylene and air
5. Oxidation of butenes to maleic acid

* In commercial operation

The bed expands until the particles begin to move. Finally, the particles are supported on the gas stream and the top of the dense-phase bed has a well-defined level, resembling a boiling liquid. Very little material is entrained with the gas and extreme turbulence is evident in the solids bed. If the gas velocity is further increased, entrainment increases to the point where the bed level disappears and a single dilute-phase suspension is present through the entire vessel, as in pneumatic conveying.

Advantages

Ease of solids handling and excellent heat transfer characteristics are perhaps the major advantages of the fluidized solids technique. Most important is that the fluidized solids technique is new to the chemical industry and may afford opportunities to carry out reactions in new ways.

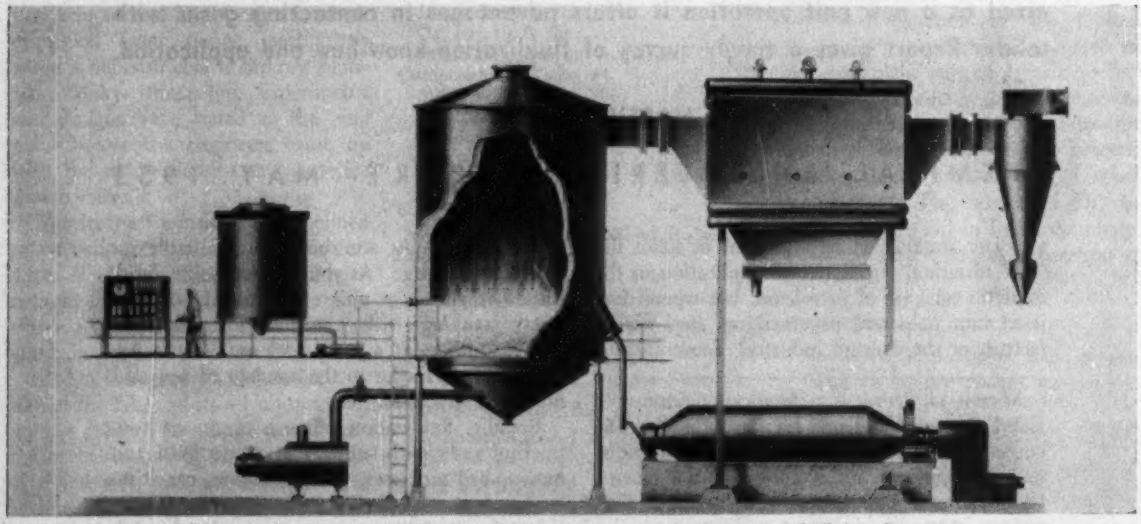
Fluidization Equipment: How It Works

Most important to successful fluidization is a proper range of solids size distribution. Various combinations of equipment then can be used.

Solids Preparation

The solids of primary interest for fluidization range from 10 to 400 mesh or from about 2,000 to 35 microns. In chemical processing it is important to prepare the solid reactant or catalyst in easily fluidizable form. The techniques which may be employed are:

1. Crushing and grinding of natural or synthetic materials.
2. Formation of microspheres from hydrogels by spray drying.
3. Spraying of molten materials into quench-



ZINC ORE ROASTER (Dorr) l. to r., controls, feed tank, blower, reactor, cooler, waste heat boiler, cyclone.

ing media. For preparation of a hydrocarbon synthesis catalyst, iron wire may be fed into a metallizing gun and sprayed into water through an atmosphere of controlled oxygen content to give spheres having a solid iron core and an oxidized surface (U.S. 2,530,344).

A mixture of coarse and fine solids tends to give optimum fluidization results. A narrow range of particle sizes gives a material with excessive tendency to channel and "bump." The maximum permissible size is in the region from 0.125 to 0.06 in. Above this, fluidization velocities usually cause excessive entrainment of any finer materials present.

Preferred sizes

A preferred distribution of particle sizes for good fluidization is as follows:

Particle Size	Preferred Percentage
0-20 microns	5-25
20-80 microns	30-85
Above 80 microns but still finely-divided	5-35

For further details on catalyst manufacture see *Chemical Engineering*, Dec. 1951, p. 157. For general information on the size reduction of ores, see *Chemical Engineering*, Aug. 1952, p. 151.

Once we have the solids prepared in fluidizable form, the next problem is to add them to the gases or vapors so that they can catalyze gas reactions or react with the gases.

Solids Addition to System

Devices for adding solids to a flowing gas stream are shown in Fig. 1. The fundamental problem is introduction of the powdered solids from a relatively low-pressure zone (in a hopper or at the base of a standpipe) to a relatively high-pressure zone (in a reactor or in a flowing fluid stream) without pelleting the solid, and at a controlled rate.

In addition to using the mechanical devices listed in Fig. 1, the solids may be introduced by pumping them in as a slurry. A thorough summary of the over-all field of feeding devices for solids is shown in *Chemical Engineering*, Nov. 1952, p. 163.

Jet valve

The so-called I.C.I. valve or "jet" valve illustrated in Fig. 1 is a non-mechanical flow control device which has been used by I.C.I. in England (Br. 607,723). It utilizes the natural angle of repose of the non-fluidized solid to halt its flow when desired. Aeration gas injected at the point indicated by the arrow disturbs the angle of repose and the flow of solids is resumed.

The centrifugal pump design shown in Fig. 1 may be operated at speeds from 200 to 5,000 rpm.; tests have been run at 1,000 rpm. It is claimed that operation substantially without erosion is possible. A one-stage turbine pump can be used for a pressure differential of 10 to 100 psi. (U. S. 2,495,152).

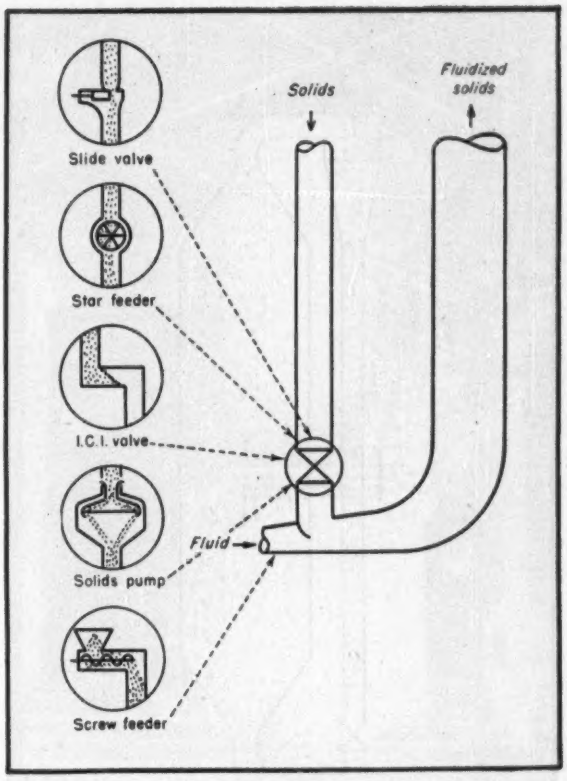


Fig. 1—Feeders used for adding solids to the fluid stream.

Flow in dense-phase standpipes may vary from free flow to a stick-slip type of flow. For safe design of pipes, the latter type of flow may be assumed, in which case the flow rate equals $0.5d^{2.5}$ tons per hour where the diameter, d, is expressed in inches. Flow is independent of the head but varies with bulk density of the solid. With free flow, the rate is proportional to the square root of the height, as with a true liquid.

Mixing nozzle

Design of the mixing nozzle at the point of solids introduction to the fluid is very important. Simply dropping the solids into the air stream in a tee will give operating troubles at all solids rates and fluid rates. A proper mixing nozzle, correctly located, influences the permissible rate of solids introduction to the system as well as the smoothness of operation.

One operating technique employed in petroleum-cracking plants is the provision of two slide valves, one above another, in catalyst downpipes. Only the lower valve is normally operated, the upper one remaining wide open.

In those instances where it is possible to pump the solids in as a slurry, the mechanical problems of sealing the solids at the point of entry may be simplified. It is necessary, of course, to supply a slurry medium which will not adversely affect the process.

Pneumatic conveying

The handling of fluidized solids mixtures at high velocities completes the cycle of solids handling. In a system as shown in Fig. 1, pneu-

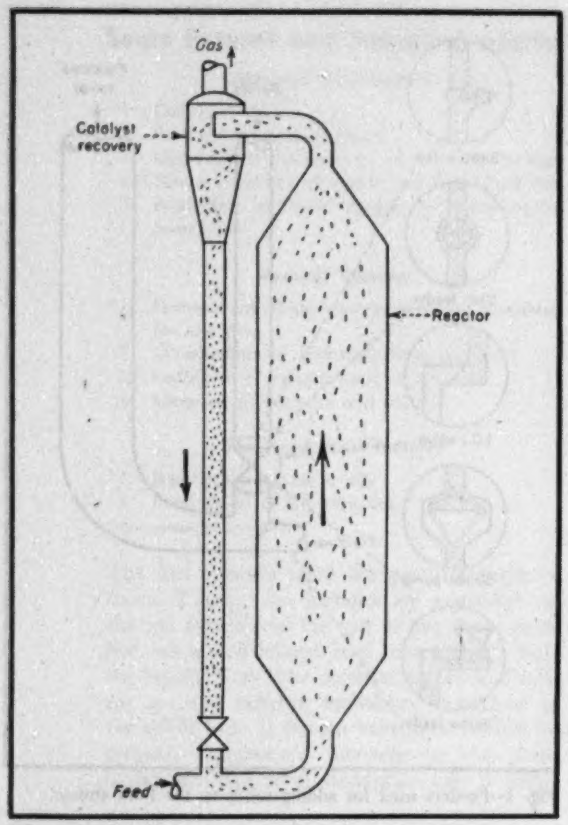


Fig. 2—Upflow dilute phase reactor opened petroleum field.

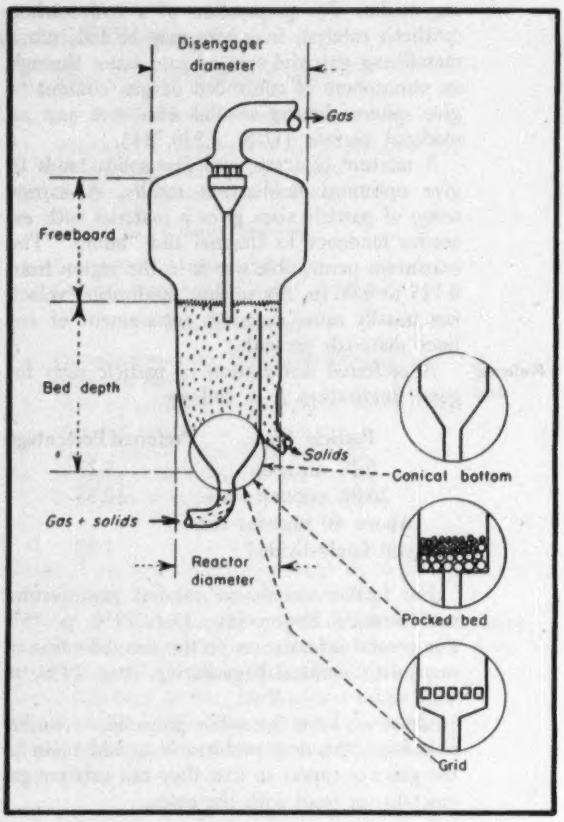


Fig. 3—Downflow dense bed reactor now carries the load.

matic conveying velocities in dilute-phase carrier lines may run from 15 to 40 feet. per sec. for materials like cracking catalysts.

While pneumatic conveying has long been used in the conveying of cement and grain from ships and freight cars to storage silos, little was known about design fundamentals until World War II. Then the stimulus of the wartime aviation-gasoline program accelerated work on all of the fundamentals underlying the design of fluidized hydrocarbon cracking units.

Pressure drop

The pressure drop in a vertical riser through which solids are being transported by a stream of gas is the sum of:

1. Pressure drop due to gas flow alone, as if no solids were present.

2. Solids pressure drop, composed of

a. A solids static head equal to vertical distance times dispersed solids density.

b. A solids friction loss due to contact of particles with the pipe wall. The Fanning equation, using solids linear velocity and dispersed solids density, is recommended for use in this instance.

c. An acceleration pressure drop. This is a factor for a considerable distance above the point where the solids begin to move vertically, and constitutes a significant portion of the total pressure drop.

Horizontal pipes

In work on conveying in horizontal pipes, a tendency has been reported toward pressure drop being independent of solids loading at high loadings. A decided centrifuging effect was found to occur at pipe bends, but a distributing vane in the downstream end of the ell corrected this; the centrifuging effect was undesirable primarily from the standpoint of erosion.

Reaction Vessels

Upflow type

The initial application of fluidized solids in the petroleum industry resulted in the upflow dilute phase reactor illustrated in Fig. 2. The obvious disadvantage of this design is that all of the flowing solids pass overhead and must be removed in dust removal equipment.

Downflow type

The basic design which finds widest application today is the downflow or dense-bed reactor. The essentials which determine the design of a downflow fluidized-solids reactor (see Fig. 3) include the following:

1. Required reaction volume. This is fixed by empirical determination of the necessary space velocity and will be influenced by the extent of gas back-mixing and the extent of solids mixing and thus by the length-to-diameter ratio of the bed.

2. Desired diameter. This is fixed by gas

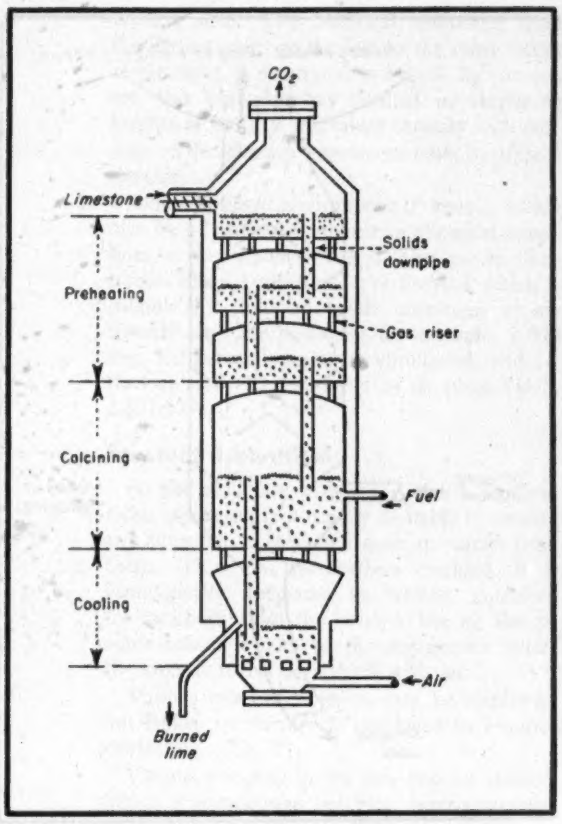
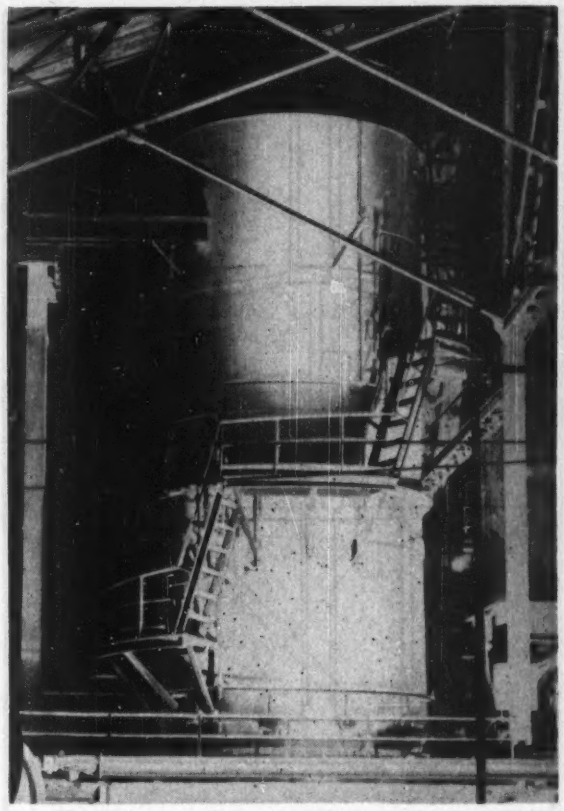


Fig. 4—Multi-compartment reactor prolongs contact time.



DORR multi-compartment unit at the New England Lime Co.

velocity, which will be within the range between the minimum for fluidization and the maximum set by excessive entrainment. The most economic velocity will be set by balancing gas circulation cost against other costs.

3. The type of gas distribution to be used.
   a. Conical bottom.
   b. Packed bed.
   c. Grid.

4. The freeboard above the reactor bed. This will be determined by the needs for dust removal equipment and the necessity for free settling prior to entry to that equipment.

5. Disengaging space diameter. The enlarged diameter lowers gas velocity, aids settling and lessens solids carryout.

6. Equipment required for heat exchange, if any.

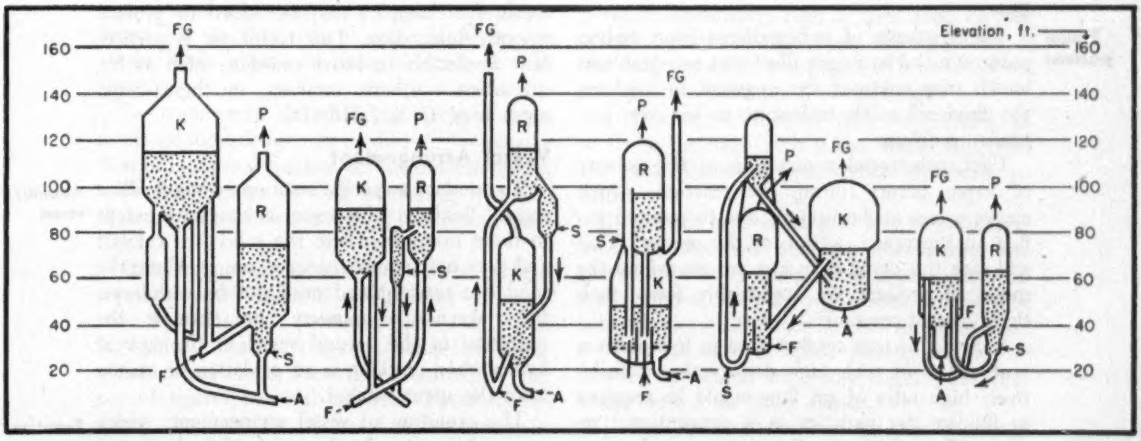


Fig. 5—Evolution of fluid cracking units, l. to r., wartime downflow unit (Model II), balanced pressure unit (Model III), stacked unit, orthoflow unit, Shell design, Model IV. F = feed, FG = flue gas, K = kiln (regenerator), R = reactor, P = product, S = steam, A = air.

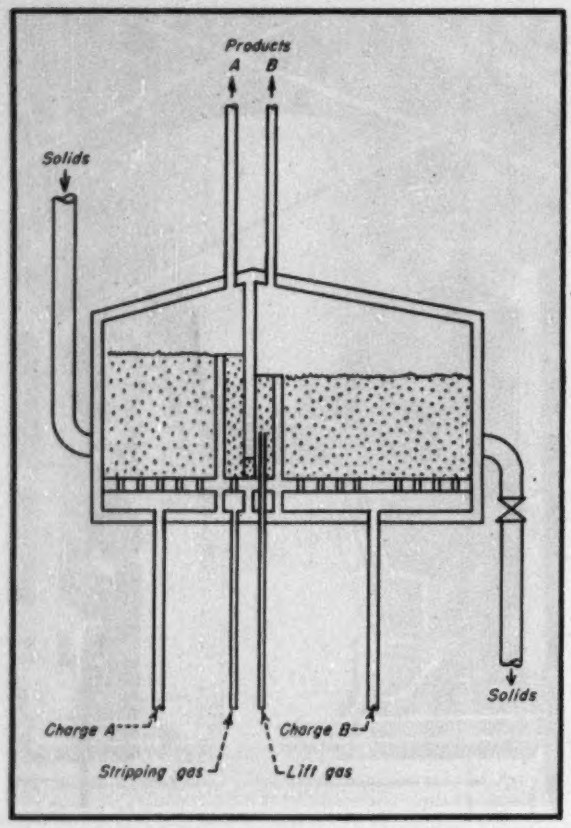


Fig. 6—High temperature contactor has no internal piping.

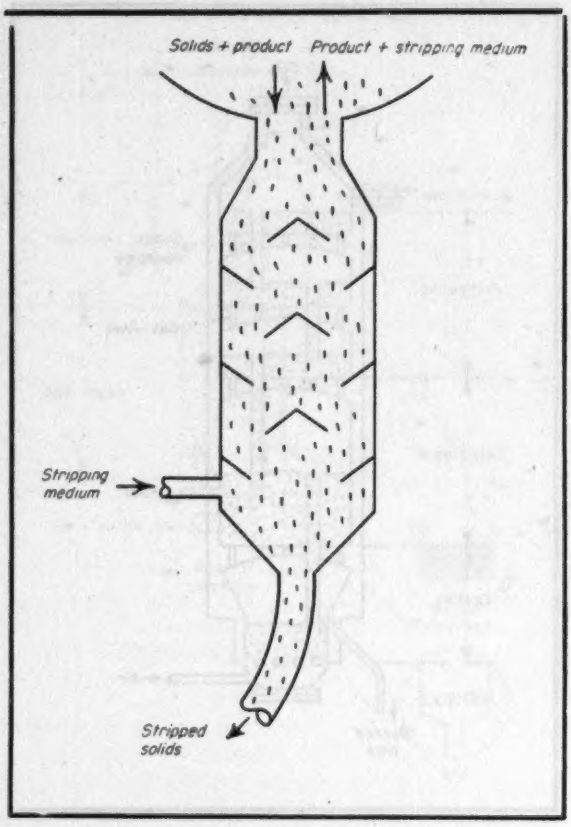


Fig. 7—Baffles improve contacting during solids stripping.

Multi-bed unit

It is apparent that in a single boiling-bed operation there will be particles which short-circuit the bed and leave rapidly, even though they have been freshly added. Similarly, some particles will undergo extremely long residence times in the bed. Where contact of all particles for appreciable times is essential, a countercurrent series of beds furnishes the answer. Fig. 4 shows such a reactor, as applied to the burning of lime.

Typical problems

The synthesis of hydrocarbons from carbon monoxide and hydrogen illustrates two problems which may confront the engineer in applying the fluidized solids technique to his own particular problem.

First, substantial contraction in the volume of vapor occurs during the reaction, which causes a loss in fluidization due to reduced gas flow in the upper portion of the reactor. This will face the designer in any process where the moles of product are appreciably fewer than the moles of reactants.

Second, the iron catalyst used in hydrocarbon synthesis is of such high density that prohibitively high rates of gas flow would be required to fluidize the particles in a conventional reactor. These high gas flow rates may be prohibitive from the standpoint of pumping cost or may be undesirable when the reaction is relatively slow and an extended contact time is desirable.

Simple baffles (of the disk and doughnut type, for example) may be employed to assist fluidization in small-diameter reactors, or where heavy solids particles are to be fluidized.

When uniform fluidization of particles in the 40-100 mesh range is difficult, an equal part of inert fines (–140 mesh and 60 percent–325 mesh, for example) may be added to provide smooth fluidization. This technique is particularly applicable to heavy powders, such as hydrocarbon synthesis catalysts, in these larger mesh sizes (U. S. 2,616,914).

Vessel Arrangement

Auxiliary vessel

To conduct a specific reaction economically a second fluidized-solid vessel is necessary except in those instances where the solid is a catalyst and does not require regeneration, or where the solid is a reactant and need not be withdrawn for conversion or recovery. For example, the operation in this second vessel in the case of hydrocarbon cracking is air oxidation of carbon from the spent catalyst.

Evolution

The evolution of vessel arrangements which occurred in the development of hydrocarbon cracking affords the best specific example of the various vessel arrangements possible in a two-

vessel system. The historical evolution, from the earliest units at the left to the most recent at the right, is illustrated in Fig. 5. As you can see, this evolution has resulted in decreasing heights of units of equivalent capacity with consequent decreases in investment costs in support structures.

One additional arrangement of vessels, which may be of particular interest in chemical operations, is that shown in Fig. 6. The specific illustration shows a setup made of firebrick which is suitable for fluidized solids operations at extremely high temperatures; for example, 2,000 deg. F. Internal piping is eliminated, and refractory wells are employed in its place (U.S. 2,521,195).

Reactant Separation

Solids stripping

As the solids are withdrawn from a fluidized solids contactor, it is usually desirable to remove any adsorbed or entrained gases or vapors from them. Thus, in hydrocarbon cracking, it is economically necessary to recover entrained hydrocarbons from the catalyst leaving the reactor before it goes to the regenerator where the coke is to be burned off with air.

Various types of strippers may be employed, but baffles are frequently employed to improve contacting (Fig. 7).

Various stripping media may also be utilized. Steam is inexpensive but may deactivate some catalysts. Natural gas or flue gas may be considered, but when liquid recovery is contemplated, either of these would blanket the condenser surface used later.

Gas cleaning

The removal of solids from the effluent gases from fluidized solids contactors is usually necessary from an economic standpoint. A comprehensive summary of dust-collection-equipment performance appeared in *Chemical Engineering*, May 1951, p. 140.

In pilot plant installations, porous ceramic filters and bag filters have been used. The porous ceramic filters can be arranged in multiple assemblies so that one or more is always on steam, while others are being blown back with inert gas.

In commercial installations, cyclone separators are most commonly used. Integral installation of cyclone separators within process vessels, with the cyclone dropleg extending into the dense phase as shown in Fig. 3, is common practice.

It is frequently necessary to follow cyclone separators with Cottrell precipitators to minimize loss of solids. In newer petroleum cracking plants, the 0-20 micron range of solids which passes the cyclones is minimized by the use of microspheroidal catalyst. These microspheres contain less of this fine fraction than ground catalyst to begin with, and higher resistance to attrition produces less fines during operation.

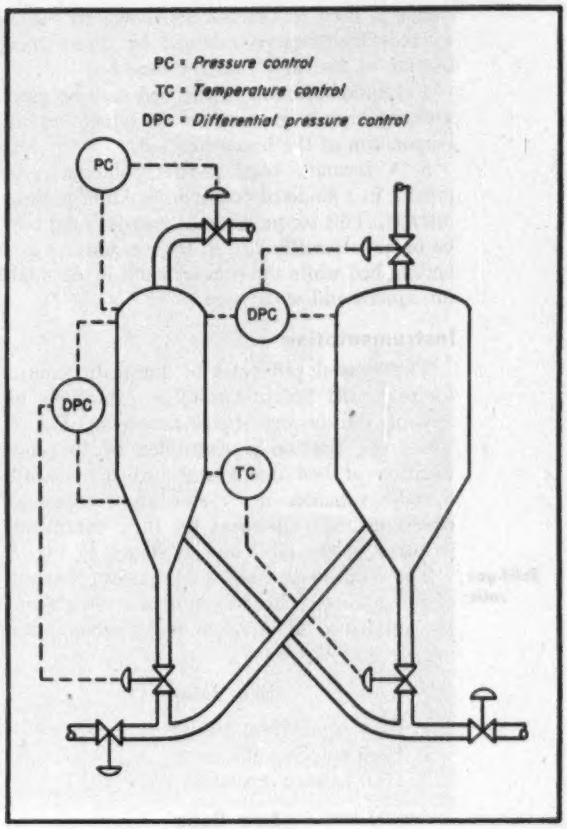


Fig. 8—Instrumentation for a fluid cracking unit.

A device which has been used to replace cyclones and Cottrells is a liquid plate-column scrubber. The feed liquid to a process may thus be used to recover effluent solids and to recover sensible heat from the effluent gas-solid mixture.

Heat Exchange

Methods

Since efficient heat transfer and excellent temperature uniformity, even at high rates of heat release, are among the major talking points of the fluidized solids technique, let's examine the methods available for heat exchange.

1. Heat transfer tubes may be inserted directly in the bed. This is the means suggested for most fluidized hydrocarbon synthesis reactors.

2. Outside heat exchangers may be employed. Early hydrocarbon cracking installations employed tubular exchangers to assist in temperature removal from the regenerator vessels. The heat transfer coefficients in such exchangers are a direct function of solids loading in the circulating gases and are many times what they would be for the gases alone.

3. Due to excellent heat transfer characteristics within fluidized beds, exothermic reactions, such as the combustion of fuel gas with air, may be carried on within the bed. This

means is used in the reactor shown in Fig. 4 wherein limestone is calcined by direct combustion of fuel in a fluidized lime bed.

4. Liquid injection to the bed may be used, whereby heat is removed as the latent heat of evaporation of the liquid injected.

5. A separate heat transfer solid may be present in a fluidized bed of the solid of primary interest. This secondary heat transfer solid may be of large particle size so that it remains as a boiling bed while the primary solid is separately introduced and withdrawn.

Instrumentation

The general principles of automatic control for two-vessel fluidized solid systems apply for any of the configurations shown in Fig. 5. Thus, the reaction is controlled by the combination of bed depth and bed temperature. Specific variables in reactor and regenerator operation and techniques for their control are itemized in the table and as shown in Fig. 8.

Solid-gas ratio

The solids-to-gas ratio is an operating variable of importance. The pros and cons of high vs. low catalyst-to-oil ratios in hydrocarbon cracking are as follows:

High Ratio

1. High equilibrium catalyst activity
2. High cracking efficiency
3. Heat-balance operation

Low Ratio

1. Less catalyst attrition
2. Lower gross coke production
3. Lower utility and investment requirements

Erosion Problems

Erosion is an important problem in the design of fluidized solids systems. Erosion in plant equipment is controlled and minimized by:

1. The proper choice of fluid velocities.

2. Streamlining of parts jutting into fluidized solids streams and streamlining of piping by the use of sweeping bends.

3. The use of protective wear plates and special liners.

Cyclone separator

For instance, choice of materials of construction for cyclone separators is critical because of the erosion problems involved. A silicon-killed carbon steel is the preferred material; it withstands erosion better than stainless alloys.

Wear plates are frequently built into cyclones to simplify maintenance due to erosion. A refractory lining composed of a refractory concrete spread over a steel mesh screen welded to the cyclone has been developed and is used to replace wear plates in some cases.

Erosion predicted

In one extremely interesting piece of fundamental work on erosion, solids suspended in air were impinged onto black iron and gypsum plaster targets. These experiments showed that erosion varied as the cube of the air velocity, attaining a maximum value at a 20 deg. impingement angle; the value at 20 deg. being twice that at 90 deg. Further, a plot of plaster-to-iron erosion ratios at various air velocities was found to be linear, suggesting the possibility of predicting iron erosion rates from measurements on plaster.

Start-up

A brief account of the start-up of a fluidized solids unit for petroleum cracking should be of interest as an introduction to operating fundamentals.

The air preheater is fired up and air at 1,000 deg. F. blown through the equipment. Catalyst is conveyed pneumatically from the storage hopper to the regenerator vessel. As soon as a bed is maintained and combustion temperature reached, oil is injected into the bed. Then the firing rate on the air heater is decreased.

The slide valve in the regenerator standpipe is opened, and catalyst transfer to the reactor is initiated using a mixture of steam and refinery gas. After a bed is built up in the reactor, the spent catalyst slide valves are opened, and air is turned into the spent catalyst carrier line, establishing the complete cycle of catalyst circulation.

As circulation increases, reactor temperature increases, and the oil charge is started to the liquid feed injection point at the base of the regenerator standpipe. Levelling off of the product recovery system is all that remains to have the entire plant on stream.

Essentials of Control for Cracking Hydrocarbons In a Fluid Catalytic Unit

Operating Variable	Method of Control
1. Oil flow	1. Controlled at constant rate.
2. Oil feed temperature	2. Controlled by preheat exchangers and/or furnace.
3. Reactor temperature	3. Controlled by regulating flow of hot fresh catalyst to reactor.
4. Reactor pressure	4. Controlled by regulating pressure at suction of compressors taking gas from product fractionators.
5. Reactor bed depth	5. Controlled by regulating catalyst flow rate to regenerator on basis of bed pressure drop.
6. Regenerator temperature	6. Controlled by regulation of coke made (as determined by catalyst/oil ratio), air rate to regenerator, and emergency quench water injected to bed.
7. Regenerator pressure	7. Controlled by regulating damper in the flue gas line. This may be regulated by pressure difference between reactor and regenerator.

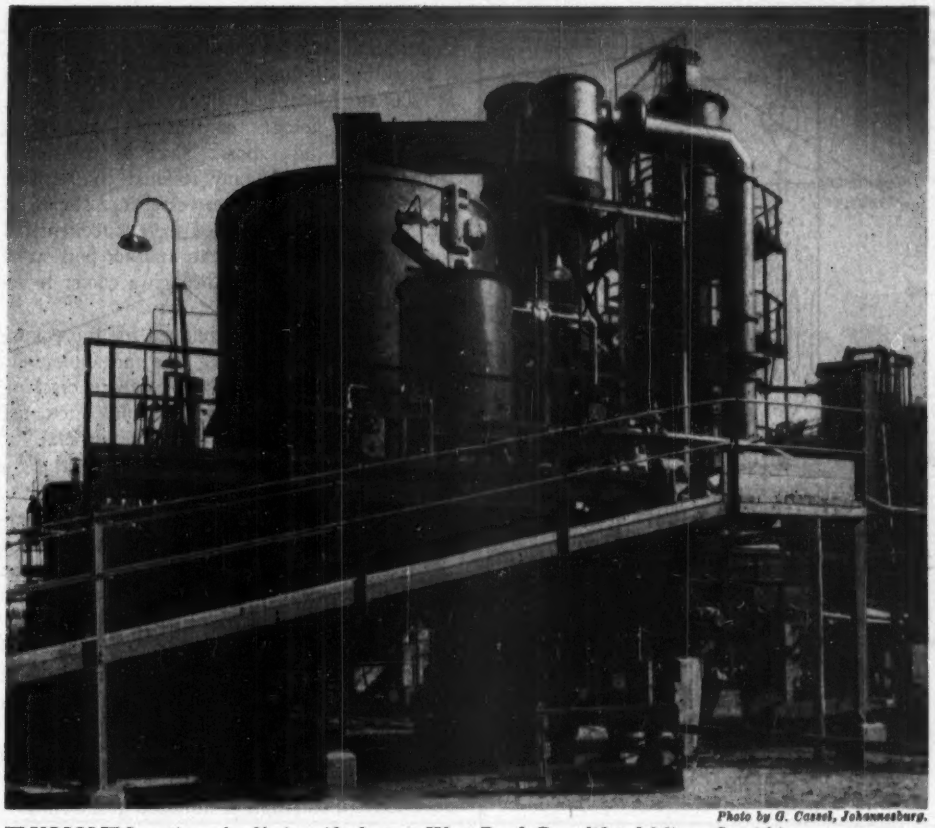


Photo by G. Cassel, Johannesburg.

FLUOSOLIDS section of sulfuric acid plant at West Rand Consolidated Mines, So. Africa.

Fluidization Benefits Many Processes

Versatility gives fluidization of solids a wide potential. Here is some of the evidence of that potential to date.

Physical Processes

Heat transfer

Fluidized solids systems are characterized heat-transferwise by excellent internal temperature uniformity and by high rates of transfer to external transfer surfaces.

The high heat content of the solids in the bed combined with radiation, conduction and convection heat transfer between particles accounts for the good internal temperature uniformity. The turbulent action of the fluidized bed aids heat transfer by all three means and reduces the tendency to localized overheating.

Heat transfer coefficients from fluidized solids through heat exchanger walls are greatly increased over cofficients at equivalent gas rates in the absence of solids. Coefficients from 30 to 70 times greater than could have been expected in the absence of solids are noted.

Evaporation

Through the use of fluidization, dry solids may be obtained from salt solutions which are hard to evaporate in conventional equipment. Thus, calcium salts which have a negative temperature coefficient of solubility and tend to precipitate out on heat exchange surfaces, or salts such as sodium sulfate which melt in their own water of crystallization, can be handled.

In a recent process (U. S. 2,567,959), hot fluidized solids of the same composition as the solution to be evaporated are used as the evaporative surface. Alternately, inert solids may be used and the dry product leached from such solids. A possible application would be evaporation of dilute sugar solutions on sand particles, followed by treatment of the coated sand with a small amount of water to produce a sirup.

Adsorption

The fluidized-bed technique has been described as applicable to the fractionation of gases using solid adsorbents. One application is shown in Fig. 9. Here the desorbed gas serves as the fluidizing medium for the solids lift line.

Another process patent (U.S. 2,606,938) covers the separation of hydrocarbons through the use of fluidized cuprous halide adsorbents.

Drying

Gases may be dried by fluidized solids, or solids may be dried in fluidized beds.

One patent discloses a method of drying gases by contact with a cold, inert fluidized solid material (U. S. 2,475,255). Cold gas plus suspended powdered ice leave the top of bed; the ice is removed by a centrifugal separator.

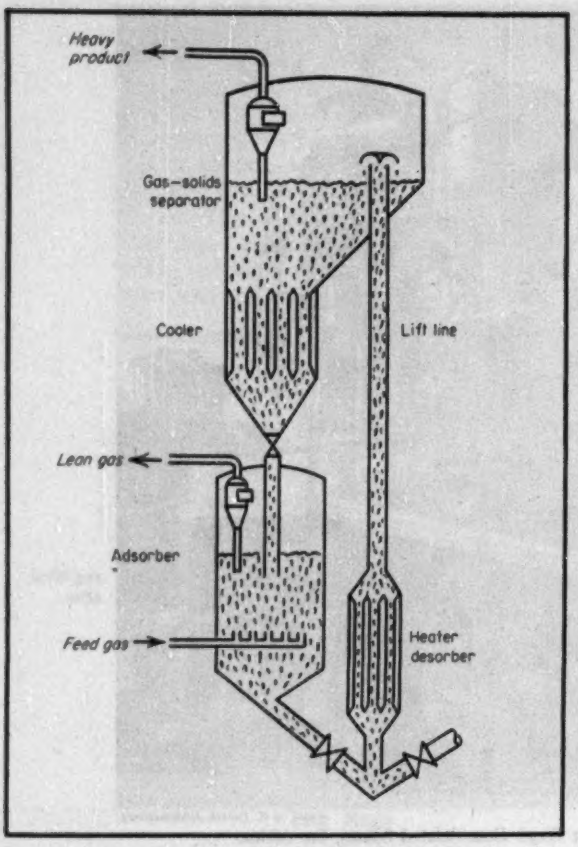


Fig. 9—Gases are fractionated in fluidized-bed adsorber.

The Dorr Fluo-Dry process, on the other hand, dries solids by blowing combustion gases through them from a direct-fired heater.

Pollution control

Dust collection and fume removal may be accomplished by the use of fluidized solids. Removal of H_2SO_4 fumes from air by such a process has been proposed.

Sizing of solids

Passage of a current of gas through a bed of fine solids may be used to size the solids, causing entrainment and removal of solids below a certain size, consistent with the gas velocity employed. This technique may be applied to the sizing of dolomite for the preparation of rotary-kiln feed. Sizing is accomplished simultaneously with drying in the Fluo-Dry process.

Size reduction

The attrition effect present in fluidized solids systems can be put to use in controlled size reduction. The fine-particle fluid energy mills marketed by various manufacturers are examples of this type of equipment.

Chemical Processes—Noncatalytic

While the initial strides in developing fluidization were associated with catalytic cracking and reforming of petroleum the technique has found a place in noncatalytic chemical processing.

Pyrolysis

Fig. 10 illustrates the layout of a plant which has been designed for the processing of oil shale, based on pilot plant operating experience.

Retorting of shale

Retorting of shale consists of maintaining it at 700 to 1,000 deg. F. for 8 to 20 min., whereby the kerogen content of the shale is converted to oil vapors. Shale is withdrawn from the retort and any residual combustible matter burned in a burner vessel in a stream of air. A portion of the burned shale is recirculated to the retort to supply heat; another portion of spent shale is processed through a cooler to recover heat as steam.

A process has been developed for the coking of petroleum, embodying the principles developed in the related fluid catalytic cracking process. The coke itself is the solid circulated and more coke is deposited on the particles.

Limestone calcining

Limestone may be efficiently calcined in a fluidized bed to yield lime and byproduct CO_2. This process has been developed to the commercial scale by the Dorr Co. in cooperation with the New England Lime Co., in whose plant the commercial installation has been made. The calcination reactor is illustrated in Fig. 4.

A possible further application of the fluidized solids technique to this process lies in a method for the manufacture of dry ice from CO_2 in a fluidized bed (U.S. 2,608,838).

Work at both Georgia Tech and Stanford University has yielded results of interest in the destructive distillation of fluidized ground wood.

Halogenation

Fluidized salts

An interesting application of the fluidized catalyst technique concerns the chlorination of methane, with reuse in situ of the hydrogen chloride produced as shown in Fig. 11 (U.S. 2,498,552).

The reactions occurring in the lower (chlorination) vessel are as follows:

$$RH + Cl_2 = RCl + HCl \quad (1)$$

$$CuO{\cdot}CuCl_2 + 2HCl = 2CuCl_2 + H_2O \quad (2)$$

$$2CuCl_2 + RH = RCl + Cu_2Cl_2 + HCl \quad (3)$$

$$2RH + Cl_2 + CuO{\cdot}CuCl_2 = 2RCl + H_2O + Cu_2Cl_2 \quad (4)$$

The HCl recovery vessel scrubs effluent cholorinated hydrocarbon plus HCl with $CuO{\cdot}CuCl_2$ according to reaction (2)

Ilmenite beach sands may be chlorinated in a fluidized bed to effect removal of the iron. Thus ilmenite sand of 6-150 mesh size is contacted with chlorine gas at 1,000 deg. C. (maintained by external heating), whereby the iron content is preferentially chlorinated. The resultant $FeCl_3$ is removed with the exhaust gases, and TiO_2 is removed from the bottom of the bed (Br. 661,560).

Methane chlorination can be carried out advantageously in a turbulent bed of inert solids, such as fine sand (U.S. 2,585,469).

The chlorination of phthalocyanines in a fluid bed as a process step in the manufacture

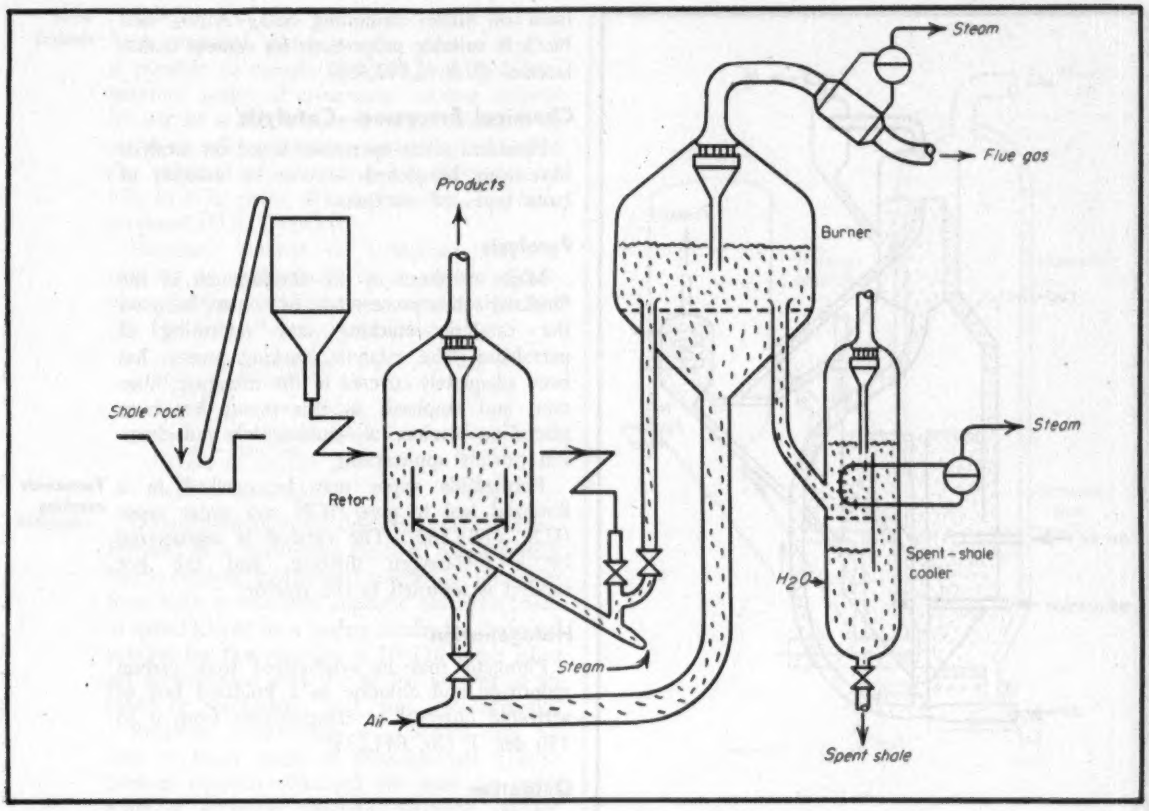


Fig. 10—Fluidization is used in retorting oil shale to convert kerogen to oil vapor.

of phthalocyanine dyestuffs is covered in a recent patent (U. S. 2,586,598).

A powdered cobalt trifluoride bed may be used for the fluorination of hydrocarbons (U. S. 2,568,660).

Oxidation

Ore roasting

The roasting of sulfide ores to produce SO_2 gas for sulfuric acid manufacture and for the preparation of paper-mill cooking liquors has been the subject of much development work. One commercial installation is at the Brown Co. paper mill in Berlin, N. H. Iron pyrites, copper or zinc sulfides may be roasted by this process.

Advantages of fluidized solids roasting include:

1. High SO_2 content of product gas.
2. Adaptability to wide range of particle sizes of feed, obviating need for fine grinding.
3. Adaptability to automatic control.
4. Elimination of moving parts in contact with hot solids.
5. Minimum external fuel requirements due to efficient combustion of sulfur.

Coal gasification

The principal ancestor of the modern fluidized solids process is the Winkler process for the gasification of brown coal which was placed in operation in Germany about 25 years ago (Fig. 12).

More recently, a large amount of work has been expended and a large number of patents are issuing on processes for the coking of coal in fluidized operations. Chemical yields can be higher than produced in ovens.

Fluidized oxides

The preparation of pure oxides of carbon from carbonaceous material, of pure SO_2 from sulfur-bearing materials, and the like may be carried out by the use of fluidized metal oxides as oxygen carriers. These procedures are based on a considerable body of thesis work at M.I.T. Such processes avoid the separation of the desired oxide product from large quantities of non-condensable gases such as nitrogen.

The activation of carbon can be neatly carried out in a fluidized bed.

Nicotinic acid

Tobacco can be "smoked" in a fluidized bed to produce nicotinic acid (niacin) for vitamin manufacture. Previous processes for nicotinic acid manufacture have centered about the oxidation of quinoline and beta-picoline with strong chemical oxidants, such as sulfuric and nitric acids.

The fluidized-bed process simply involves fluidization of finely-ground tobacco with humid air at 150-220 deg. F. for about 22 hrs. Nicotine content of the tobacco is completely oxidized to nicotinic acid (U.S. 2,586,-808). The product is extracted with water or alcohol.

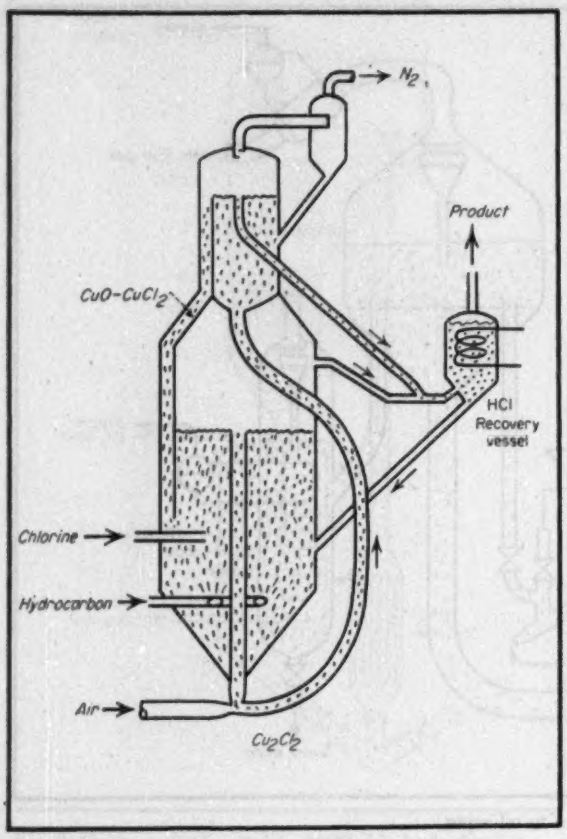


Fig. 11—Methane chlorination by fluidized solids technique.

Hydrazine hydrate Ammonia may be oxidized to hydrazine hydrate in a fluidized bed of reducible metal oxide. The reducible oxide is re-oxidized in a second fluid bed and returned to the first bed, where it acts as the oxidizing agent (U.S. 2,583,585).

Reduction

Iron ore Iron oxide may be reduced with hydrogen in a fluidized bed (U.S. 2,343,780). Hydrogen derived from pyrolysis of natural gas is introduced at 1,000 deg. F. Additional heat may be supplied to the fluidized bed, when needed, by admission of air to burn a portion of the hydrogen. For other data on the direct reduction of iron ore in a fluidized bed, see *Chemical Engineering*, April 1952, p. 161.

Miscellaneous

Carbon disulfide The present electric furnace process for manufacture of carbon disulfide, with its high electric power costs, may find a competitor in the fluidized solids field. Powdered coke may be reacted with sulfur vapors at 1,400-1,600 deg. F. to produce CS_2 (U.S. 2,443,854). The heat required for the reaction (52,000 Btu. per lb. of CS_2 formed) is supplied by combustion of a portion of the carbon.

Cement may be made in a fluidized bed from oil shale containing SiO_2, Al_2O_3, and Fe_2O_3 in suitable proportions for cement manufacture. (U.S. 2,592,468).

Chemical Processes—Catalytic

Fluidized solids operations based on catalysis have now broadened to cover a number of basic types of reactions.

Pyrolysis

Major emphasis in the development of the fluidized solids process has, of course, been on the catalytic cracking and reforming of petroleum. The catalytic cracking process has been adequately covered in the literature, however, and emphasis in this report has been placed on mechanical fundamentals and chemical process applications.

Formamide cracking Formamide vapor may be cracked in a fluidized bed to give HCN and water vapor (U.S. 2,604,380). The catalyst is regenerated by a fuel-oxygen mixture, and the hot catalyst is returned to the reactor.

Halogenation

Phosgene may be synthesized from carbon monoxide and chlorine in a fluidized bed of activated charcoal at temperatures from 0 to 150 deg. F (Br. 644,135).

Oxidation

Phthalic anhydride Application of the fluidized bed process to the manufacture of phthalic anhydride and a comparison of the virtues of the fluidized vs. fixed bed processes for phthalic is presented in *Chemical Week* Feb. 23, 1952 p. This article points out that Sherwin-Williams is expanding their pioneer plant and that I.C.I. is building a fluid bed unit in England.

Equipment and reaction conditions have been specified for the production of phthalic anhydride from naphthalene (Br. 644,135). Suggested reaction conditions are:

Reaction temperature	690 deg. F.
Reactor pressure	3 psi. gage
Inlet temperature of naphthalene vapors	450 deg. F.
Inlet temperature of air	100 deg. F.
Molar ratio of air to naphthalene vapors	30
Lbs. V_2O_5 in reactor per lb. naphthalene per hr.	1–10

Using the fluid catalyst process, operations within the explosive range are quite permissible. Thus, in the old fixed-bed process about 25 to 30 lb. of air per lb. of naphthalene were employed—a 500–600 percent excess. In the fluidized bed operation, air-naphthalene weight ratios of 15 to 1 are employed.

Ethylene oxide Ethylene oxide from ethylene and air in a fluidized bed has been the subject of research in a number of organizations. A process developed by Atlantic Refining Co. in cooperation with the Vulcan Copper and Supply Co. and available for license through Vulcan has recently been announced.

Sulfur trioxide

Oxidation of SO_2 to SO_3 in a fluid bed has been proposed, purely on the premise that it is possible to operate within a restricted temperature range of maximum catalyst activity by use of a fluidized bed. Also, oxidation of sulfur or sulfur-containing materials with air in the presence of a catalyst for conversion of SO_2 to SO_3, giving SO_3 in one step, has been proposed (U.S. 2,449,190).

Benzene, butenes or butadiene may be oxidized to maleic acid in an upflow dilute-phase fluidized molybdena-vanadia catalyst bed (Br. 660,329). Reaction conditions are:

Reaction temperature ..	800–1,100 deg. F.
Mole % butenes in air charged	1.4–3.0
Catalyst concentration, lb./cu.ft.	1.0
Mole % MoO_3 in catalyst	34.2
Contact time, sec.	0.3–0.6
Oxygen in aeration gas, %	6–21
Catalyst mesh size.....	40–80

Aldehydes

Unsaturated aliphatic aldehydes may be manufactured in a continuous fluidized solids system by the catalytic vapor-phase reaction of formaldehyde with a saturated aliphatic aldehyde, such as acetaldehyde or a higher aldehyde. Preferred catalyst for this reaction is 50–120 mesh silica gel impregnated with 0.1 to 5.0 percent of an oxide of manganese, lead, zinc, or cadmium.

Reaction temperature is 200–450 deg. C. One to three moles of formaldehyde (10–50 percent aqueous solution) are used for each mole of saturated aliphatic aldehyde. Water evaporating from the formaldehyde solution provides diluent steam. The catalyst becomes coked and is withdrawn to a separate vessel for regeneration with air or oxygen at 300 to 500 deg. C (U.S. 2,517,006).

Ammonia may be oxidized to oxides of nitrogen at temperatures of 600 to 1,000 deg. F. over a fluidized sintered iron oxide catalyst promoted with 2 percent alumina and 1 percent K_2O (Br. 644,135).

Reduction

Hydro-Carbons

Hydrocarbon synthesis from carbon monoxide and hydrogen has long offered a difficult problem in heat transfer. The German Fischer-Tropsch process employed thin layers of catalyst between cooling surfaces and 6 million square feet of cooling surface were required for a 10,000 bbl.-per-day plant. In contrast, the fluidized American version of the process requires less than 1 percent this amount of cooling surface.

The reduction of nitro compounds to amines is an exothermic reaction involving a gas and a solid catalyst, ideally suited to the application of fluidization (U.S. 2,620,356).

Miscellaneous

The polymerization of olefins over a phosphoric acid catalyst supported on kieselguhr in fluidized form has been proposed (Br. 644,135). In this case, the operation would be carried on without regeneration until the catalyst becomes permanently inactive. It then would be withdrawn and a fresh supply added. Operating temperatures of 300 to 600 deg. F. and pressures of 200 to 1,500 psi. are specified.

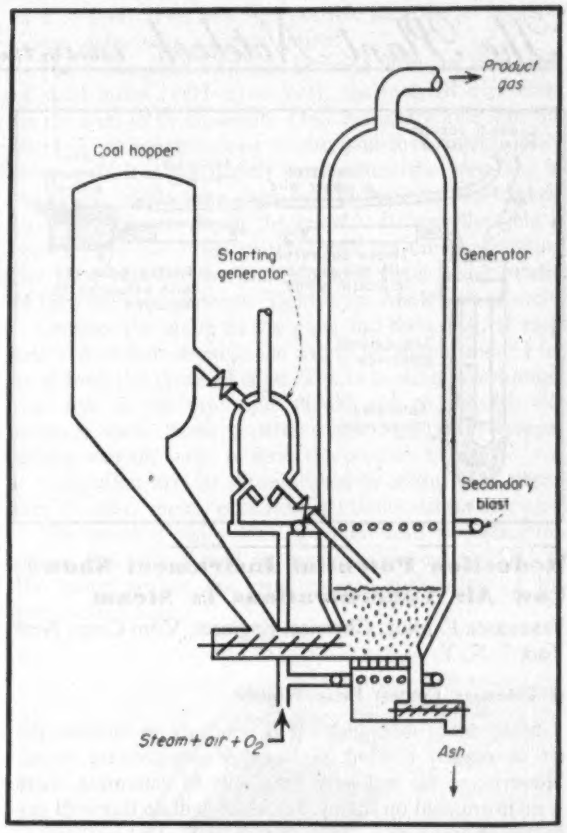


Fig. 12—Winkler gas producer, predecessor of modern units.

Benzene or toluene may be nitrated in the vapor phase, using fluidized iron, cobalt, nickel, or platinum catalysts. Reaction temperatures of 100 deg. C. for benzene and 0–100 deg. C. for toluene are preferred (Br. 644,135).

The desulfurization of petroleum in a petroleum cracking operation may be carried out in a separate reaction vessel, but using the same cracking catalyst.

In the reaction of SO_2 with hydrocarbons to give thiophene, extensive side reactions and low thiophene yields have characterized fixed-bed operation due to difficulty of close temperature control. However, finely-divided chromia-alumina catalyst was used in fluidized-bed operation with great success.

NEXT MONTH . . .

Watch for our 48-page Report on Heat Technology—an integrated symposium of 12 articles on production, containment, transport and transfer of heat. Look too for the "Thermal Spectrum Chart."

The Plant Notebook

Edited by Theodore R. Olive

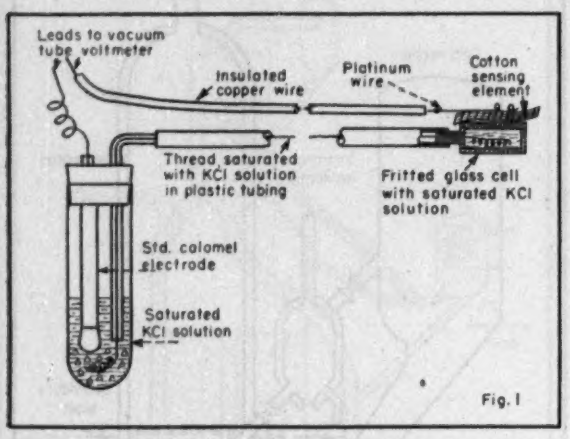


Fig. 1

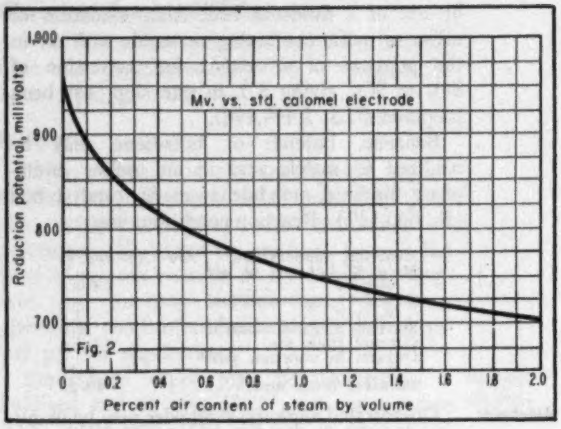


Fig. 2

Reduction Potential Instrument Shows Low Air Concentrations in Steam

FREDERICK FAHNOE, *Chemical Engineer, Vitro Corp., New York 7, N. Y.*

★ **February Contest Prize Winner**

Many times in industry it is necessary to measure the air or oxygen content of open or low-pressure steam. However, so far as I have been able to determine, there is no instrument on the market which will do this with any degree of accuracy.

For example, steam ageing of dyestuffs is one application where the presence of air in steam is extremely deleterious; other instances where air content is undesirable are in reduction processes, both inorganic and organic, where live steam is employed as a heating medium. A means of measuring air content of steam either in a flow system, or spatially within a steam chest or chamber, has been needed.

A test system has now been devised which can be adapted either as a probe or as a fixed element for measuring air content of steam below 2 percent by volume with high accuracy. The structural arrangement of this system is shown in Fig. 1. The principle is based on the lowering of reduction potential of dispersed formaldehyde sodium sulfoxylate (Rongalit) with air at steam temperatures. The actual reduction system consists of the potential established between platinum and calomel electrodes by cotton cloth which is impregnated with the reduction mixture. A typical impregnating mixture is constituted as follows:

	Percent
Formaldehyde sodium sulfoxylate	7½
Glycerine	7½
Starch	8½
British gum	16
Potassium carbonate	15
Water	46½

Use of this cotton cloth detector, as shown in the illustration, permits practically instantaneous reading of reduction potential by a vacuum tube voltmeter. The potential exists for several minutes after which the cotton sensing element must be replaced. A typical calibration curve for this unit appears in Fig. 2.

It will be noted that this device has excellent sensitivity in the low air content range for which no commercially available instrument is satisfactory. The utilization of this device in the form of a probe should permit a study of steam distribution in any chamber to locate stagnant areas, to determine the desirable location of baffles, and so on. The instrument should be capable, as well, of adaptation to permit the measurement of air content of steam which is flowing at low pressure in a pipe or duct.

★ **March Contest Prize Winner**

"New Clamp Design Simplifies Installation of Coils and Pipes in Process Vessels."

A prize of $50 in cash will be awarded to Stanley Yokell, chemical and professional engineer, Fairlawn, N. J. Mr. Yokell's article, his third winner, will appear in the plant Notebook for July.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering*, will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Articles which are acceptable but are not winners will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

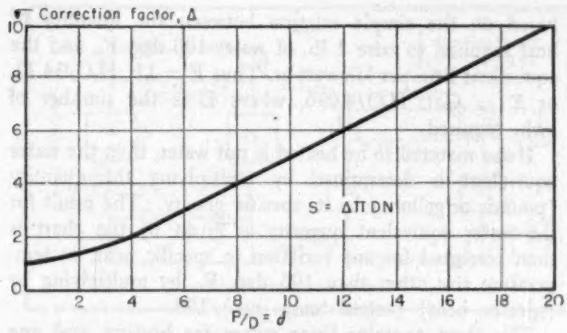
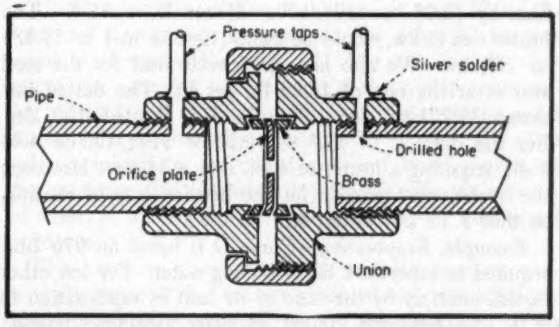


Chart Saves Times in Determining Length of a Helix

L. Shprintz, *Chemical Engineer, Publicker Industries, Inc., Philadelphia, Pa.*

When the pitch P of a helix of mean diameter D is small in comparison with the diameter, then there is not much error in calculating the length as $N \pi D$, where N is the number of turns. If $P/D < 0.5$, then the error will be less than 3 percent. However, for other cases the error can be considerable. The chart above makes it unnecessary to go through lengthy calculations where accuracy is needed. With it it is only necessary to solve the equation $s = \Delta N \pi D$, where Δ is a correction factor obtained from the chart for the particular ratio of $P/D = \delta$ to be used.

In polar coordinates the equation of a helix is $x = a \cos \theta$, $y = a \sin \theta$, and $z = b\theta$. The length of the helix is then the integral from 0 to 2π of $(a^2 \sin^2 \theta + a^2 \cos^2 \theta + b^2)^{0.5} d\theta$ or $(a^2 + b^2)^{0.5}$ times the integral from 0 to 2π of $d\theta$. For one turn, then, length $s_1 = 2\pi (a^2 + b^2)^{0.5}$. Now, $D = 2a$ and $b = P/4$ so that $s_1 = 2\pi [(D/2)^2 + (P/4)^2]^{0.5}$. Hence, for N turns, $s_N = N \pi D (1 + \delta^2/4)^{0.5}$ where $\delta = P/D$. A plot of the expression $(1 + \delta^2/4)^{0.5} = \Delta$ vs. δ is the correction factor and hence $s_N = \Delta N \pi D$.



Simple Orifice Construction Based on Pipe Union

Jack Lowenstein, *Chemical Corps Engineering Agency, Army Chemical Center, Md.*

In process laboratory work it is often necessary to measure flow through small diameter pipe by means of an orifice. Since small fittings are usually threaded, flanges—the standard orifice-mounting devices—are rarely available in sizes of ½ to ¼ in. It is, however, possible to make an accurate orifice meter using a regular union.

The orifice plate itself may be made from any thin piece of sheet metal (0.03 in. or less), the material depending on the fluid to be measured. Drill the orifice hole into the sheet metal before cutting to size, and then cut the plate down until it is just slightly smaller than the brass ring in the union. (The brass rings may be milled down slightly to obtain a better fit for the insert.) Be sure the hole is centered on the orifice plate! Close the union, clamping the plate between the brass surfaces, again being careful to keep the hole centered. Tighten the whole unit securely.

Connect the union to the pipe, and then drill, at each end, a ⅛-in. hole through one wall of the union, about ¼ in. away from the threaded edge. The hole must pass through one wall of the pipe, but should not go through the opposite wall. Braze or silver-solder ¼ or ⅛ in. copper tubing over the holes to form the pressure taps.

Calibration may be accomplished by means of a rotameter, or other meter, producing a smooth calibration plot.

The union is easily taken apart to clean or replace the orifice, but care should be taken to prevent rotation of the union against the pipe, causing dislocation of the pressure-tap holes.



"Hose Chute" Reduces Dusting

Dust from fines dropped on to a surge pile from an elevated belt conveyor was a serious nuisance at a Kingston, N. J., trap rock crushing plant. The primary crusher produced a high percentage of fines and the drop from the head of the conveyor was often as much as 40-45 ft. A metal pipe attached to the bottom of the discharge chute wore out quickly so it was decided to try hose.

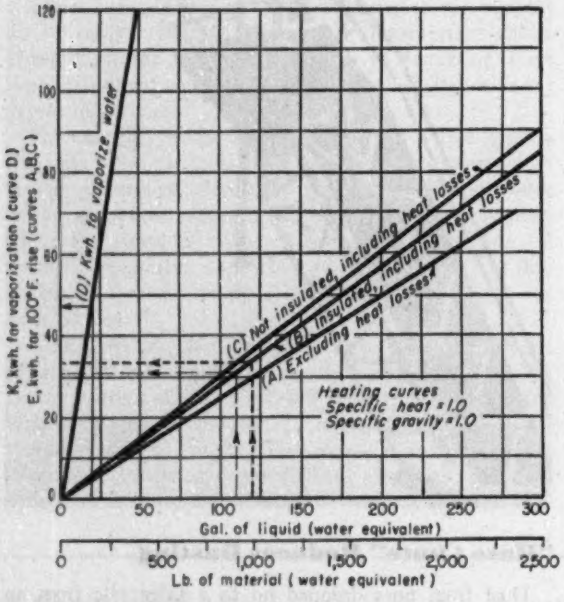
The solution, worked out by the Thermoid Co., of Trenton, uses two lengths of large-diameter wire-reinforced hose, similar to suction dredge hose. The smaller one, 7½ in. O.D., is attached to the bottom of the discharge chute and is 25 ft. long. The larger one telescopes

over the smaller and is 20 ft. long. It is supported and adjusted as to height by a flange attached to the bottom and cables which are controlled from the hopper to deliver just above the top of the pile. Thus there is little chance for wind to blow the fines over the surrounding area.

Extra Lubrication Saves Catalyst Pump

A Moyno positive displacement pump was showing excessive wear while pumping a slurry of fluid cracking catalyst in American Cyanamid's Fort Worth, Texas, plant. The cure, suggested by repairman R. B. Poteet, was worth $600 to him via the plant's suggestion system. At the drive end there is a connecting rod driven through a pin which acts as a universal joint. This is normally packed with grease but there was no way to provide sustained lubrication. The greatest wear was taking place at the joint between the pin and the connecting rod knuckle-joint.

Mr. Poteet drilled a passage lengthwise through the drive shaft into the space containing the trouble-giving parts. By attaching a grease fitting at the end of the shaft he was able to ensure adequate lubrication. However, the method would not be recommended if the possibility of lubricant leaking into the product offered serious objections.



Curves Cut Work in Determining Electric Energy for Heating

JOSEPH GIALANELLA, *Chief Engineer, Amersil Co., East Newark, N. J.*

The chart above is a handy one for quick estimation of the energy requirements for the electric heating of liquids or solids. It has been drawn for water but can easily be corrected for materials having a specific gravity other than 1.0, or a specific heat other than 1.0. The chart is based on the simple relation between the quantity of heat required to raise 1 lb. of water 100 deg. F., and the equivalent Btu. per kilowatt-hr. Thus E = Lb. H_2O/34.12, or E = Gal. H_2O/4.096, where E is the number of kwh. required.

If the material to be heated is not water, then the water equivalent is determined by multiplying the quantity (pounds or gallons) by its specific gravity. The result for the water equivalent quantity as given by the chart is then corrected for any variation in specific heat, or temperature rise other than 100 deg. F., by multiplying by (specific heat) (actual temp. rise)/100.

The chart contains three curves for heating, and one for evaporation of a liquid. Curve A is theoretical and includes no heat loss. It is used where heat losses can be determined. Curve B includes heat loss of about 15 percent and is based on using insulation. Curve C includes heat loss of about 25 percent and is based on using no insulation. Curve D, for vaporization, is based on evaporation of water at its boiling point. Heating water to its boiling point must be figured separately by one of the heating curves. To evaporate another liquid, multiply by the ratio of heat of vaporization to that of water.

USING THE CHART

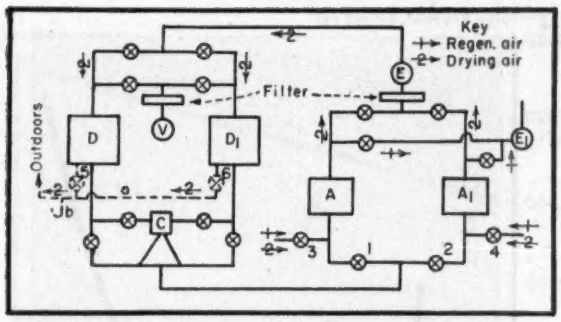
For those who want to reproduce the chart larger, draw the curves through zero and one additional point at 100 gal. as follows: Curve A, 24.4; Curve B, 28.1; Curve C, 30.5 kwh.; Curve D at 20 gal. is 47.4 kwh. For the weight scale of abscissas, 120 gal. H_2O = 1,000 lb.

Example, Heating—55 gal. of plating solution of 1.05 sp. ht. and 2.0 sp. gr. is to be heated from 70 to 180 deg. F. in 3 hr. in an insulated tank. A weight of 1,000 lb. per hr. of steel articles (sp. ht. = 0.12) is to pass through the tank each hour. Find the energy requirements and the size of heater needed.

The water weight equivalent of the solution is 55 × 2.0 = 110 gal. Using curve B the value of E would be 31 kwh. per 100 deg. rise. For 1.05 sp. ht. and 110 deg. F. rise, multiply this value, as shown by the dashed line, by (1.05 × 110)/100. Hence E = 35.8. The heater size in kw. would be kwh./(time in hr.) = 35.8/3 = 11.9 kw. We also have to provide heat for the steel articles at the rate of 1,000 lb. per hr. The dotted line shows 33.7 kwh. for 1,000 lb. H_2O heated 100 deg. For the steel, E = 33.7 × (0.12 × 110)/100 = 4.44 kwh., requiring a heater of 4.44/1 = 4.44 kw. However, the heater must provide for the heavier duty of starting, so that a 12 kw. heater will be used.

Example, Evaporating—Curve D is based on 970 Btu. required to vaporize 1 lb. of boiling water. For any other liquid, multiply by the ratio of its heat of vaporization to 970. To evaporate 20 gal. of water (see solid line on chart) requires 47.4 kwh. For 20 gal. of ethyl alcohol, for example, 47.4 × 374/970 = 18.3 kw. would be required. Heats of vaporization of a few liquids are as follows:

	Btu./Lb.
Acetone	224
Benzene	710
Carbon tetrachloride	84
Ethyl alcohol	374
Methyl alcohol	177
Water	970



How Vacuum Dryers Were Converted For Three-Way Operation

FRANK GIBADLO, *Process Chemical Specialties, Beverly, Mass.*

This article describes how a vacuum shelf dryer installation, originally set up to dry either by vacuum or by recirculation of dehydrated inert gas, was converted at little expense for a third mode of operation—the once-through passage of dehydrated room air.

The pair of vacuum shelf dryers was designed to remove water from various pyrophoric metallic powders and their alloys such as Ti, Zr, Ta, Cb, U, etc. These wet powders have the appearance and consistency of wet mud and normally contain 20-30 percent water. The wet powders were spread upon the numerous stainless steel shelves within the dryers *D* and D_1. The moisture could be removed by either of two methods—first, by creating a vacuum in the closed dryers with vacuum pump *V*. If necessary, heat was supplied to the shelves by steam or hot water. Or second, an inert atmosphere of He or A could be recirculated through the dryers by exhauster *E*. The He or A picked up water from the powders and then passed into the silica gel adsorbers A and A_1, where the water was stripped. As an optional procedure the inert gas could be passed through cooler *C* if too hot, prior to entering the adsorbers and thereby increasing the stripping efficiency.

Under average operating conditions it took 12 hr. to load and dry a batch of powder. The other 12 hr. was spent to regenerate the silica gel. This was done by closing off the adsorbers from the rest of the system and opening valves 1 and 2, allowing air from the room to purge through the adsorbers by running exhauster *E*. The silica gel was heated by embedded electrical heating units to the recommended temperature to insure efficient removal of adsorbed water. The moisture-laden air was then piped outdoors.

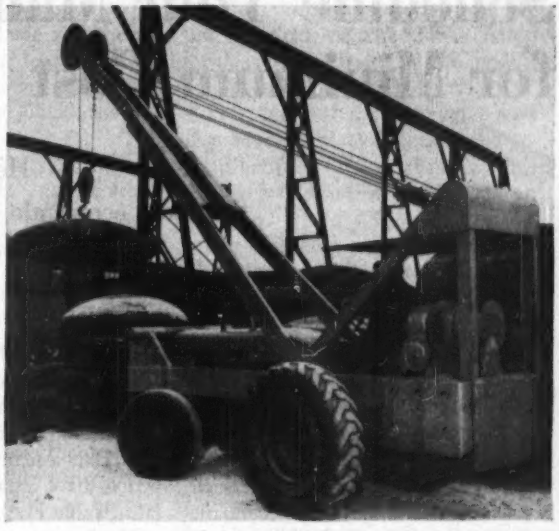
The handling of some of these metallic powders, particularly those of the courser grade which were relatively inert to oxidation, did not require the protection of an inert atmosphere or vacuum. They could be air-dried without undue hazard—although provisions were taken to prevent ignition by static.

To obtain the economy and increased production with air drying, we made a few simple and inexpensive changes and additions. As shown in the sketch, the dotted line represents the additional pipe line a, containing the two valves 5 and 6 connected to each dryer with the open exit leading outdoors. A U-tube *b*, with a water seal to prevent the leakage of air into the room, was connected to this new pipe line at its lowest point in order to drain off any excess condensate.

With this new arrangement valves 1 and 2 were shut, valves 3 and 4 were opened, thus allowing air from room to be drawn by *E* into the electrically heated adsorbers A and A_1, raising the air temperature to the desired level. The air flowed into dryers *D* and D_1, and finally was led outdoors as moisture-laden air through new pipe line a. Some degree of flexibility was obtained by utilizing either one or two dryers or adsorbers.

The temperature of the circulating air was controlled by varying its volume by valves 3 and 4.

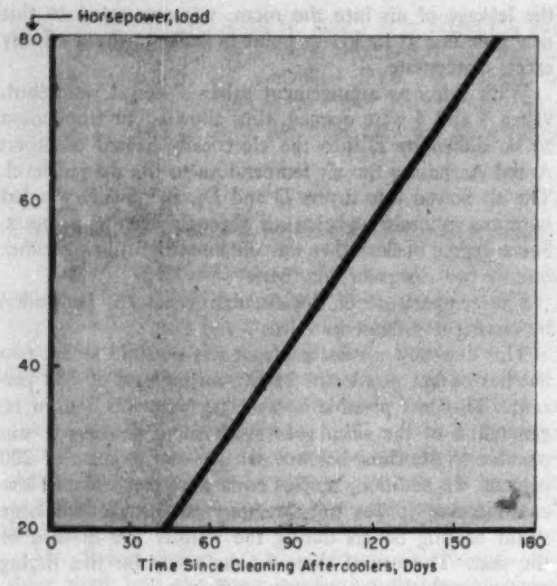
This new flow system made, it was possible to dry two batches of wet powder in 24 hr., an increase of 100 percent. This was possible because no time was lost in regeneration of the silica gel. With some powders it was possible to dry three batches per day—an increase of 200 percent. In addition, process costs were considerably lowered because it was not necessary to operate the large steam heating boilers during the warmer five months of the year. The use of these boilers solely for this drying process would have been very inefficient.

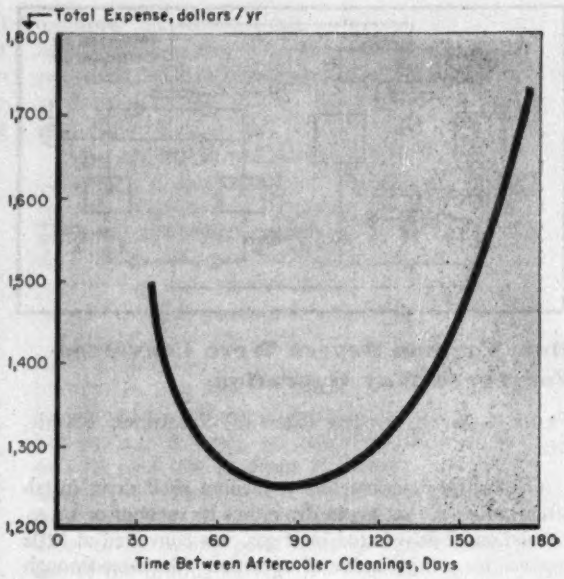


Quick Lift for Heavy Parts

An idea being used by Glascote Products, Inc., at Cleveland, has possibilities in plant maintenance shops and equipment salvage departments. Glascote handles many dished heads for process vessels, ranging in size to 10 ft. diam. and up to 2 tons in weight. These are awkward and offer no convenient hold for lifting. In addition, they are difficult to stack and store.

Previous clumsy handling methods are obviated by a new method which consists in applying temporary fasteners to the center of the domed head by means of a Nelson stud welding gun. Four ½ x 2-in. studs are welded to the center of the head, using a four-hole ringed lifting plate as its own template. This enables the heads to be lifted horizontally by means of a mobile yard crane, and permits them to be stacked readily.





Schedule Your Maintenance for Minimum Cost

Here's how the process engineer can determine the most economic operating cycle for process equipment which shows a decline in performance as a function of time.

ROBERT L. AHLNESS

Frequently the process engineer in the chemical industries is called upon to prepare a maintenance schedule for plant materials and equipment. Economic and engineering factors must be carefully weighed before such a schedule is arranged. The economic balance constitutes a flexible tool in the attack of this problem.

When any material or equipment used in a process shows a decline in performance as a function of time, an economic time interval exists at the end of which the material should be replaced or the equipment reconditioned.

FOULING OF AFTERCOOLERS

Consider a hypothetical petrochemical plant in which gas compression forms an integral step in the process. Operating experience has shown that hydrocarbon polymerization causes the compressor aftercoolers to foul rapidly. Data assembled over an extended period have established the fouling rate (Table I).

The increase in pressure differential through the coolers places an increasing work load on the compressors. At what time interval would it be most economical to clean the aftercoolers?

By establishing the compressor throughput and by utilizing thermodynamic formulas, the incremental horsepower over that required with clean aftercoolers may be determined at given time intervals. A graph is prepared of these data (Fig. I).

By integrating the area under the curve, the incremental work (power × time) for any given interval may be established. It may be assumed that the compressors are driven by natural gas engines and that the thermal efficiency of the units has been determined. Similar computations may be made for steam turbine or electric motor drives.

By utilizing the price of gas, it is possible to determine the incremental fuel gas cost for operating the compressors for any period of time after cleaning. Operating labor, operating materials, and overhead costs at the compression step may be assumed to be constant regardless of the degree of fouling of the aftercoolers.

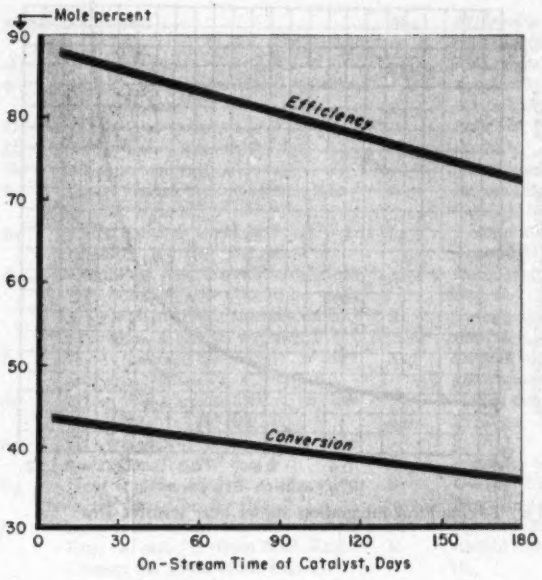
The fixed cost of labor and supervision for cleaning the coolers is next

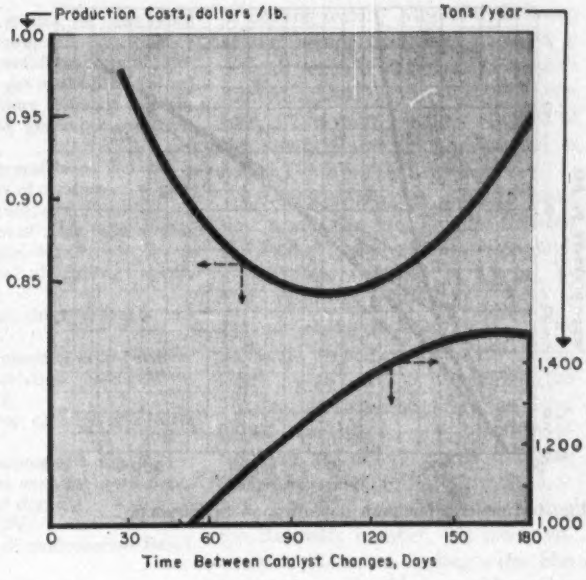
Table I
Operating Data, Compressor Aftercoolers

Days since last cleaning	0	30	60	90	120
Compressor discharge, psig.	66	70	74	78	82

Compressed gas is delivered, after cooling, for further processing at a constant pressure of 60 psig.

ROBERT L. AHLNESS *is a process engineer with Phillips Chemical Co., Borger, Tex. He is winner of the Sept. 1951 Plant Notebook contest.*





established. This cost may be assumed to be relatively independent of the time interval between cooler cleanings.

With the above data, the final step in the determination may be made. A series of time intervals is chosen. The yearly costs for operating and cleaning may be computed for the given time intervals.

A graph prepared in this manner is shown in Fig. 2. The optimum cleaning time is clearly established. Accuracy of the method is dependent only on the accuracy of the data.

DECLINE IN CATALYST PERFORMANCE

A second example has been chosen to illustrate the handling of a second variable, the plant production. In this case the catalyst is the material exhibiting a decline in performance as a function of time.

Consider a chemical plant using a fixed bed catalytic process. Plant tests have established the catalyst decline curves. A graph of this type is shown in Fig. 3.

Conversion refers to the percentage of the moles of feed converted to the desired product plus the moles of feed destroyed in a single pass over the catalyst. Efficiency refers to the percentage of the conversion figure which was converted to the desired end product in a single pass over the catalyst.

According to the graph catalyst activity declines with time. What is the optimum economic time interval between catalyst changes?

First step in the determination is the preparation of a table with headings similar to those presented in Table II. Production costs should be tabulated for various assumed catalyst life periods.

Costs to be shown are only those applying directly to the catalyst area. The cost of catalyst and the labor cost for changing catalyst should be included. Also to be shown is the possible production with the catalyst replaced at the given intervals. Adjustment should be made in the tabulated figures for the production lost during the catalyst change. The desired cost data for completing the table may be obtained from the process accounting group at your plant.

Summation of the costs of operation for the given interval and the cost of the catalyst and catalyst change should next be divided by the production possible during the period.

Table II—Determination of Economic Catalyst Life Period

1. Interval between catalyst changes
2. Fixed charge for catalyst
3. Cost of catalyst change
4. Operating expenses
5. Overhead charges
6. Cost of feed destroyed over catalyst
7. Cost of feed lost in recycle
8. Total possible production in interval
9. Cost in dollars per pound for production in interval
   (Sum of 2 through 7, divided by 8)
10. Possible yearly production with given number of catalyst changes

The above costs and calculated figures should be determined for each interval between catalyst changes. For example, one set of figures assuming a catalyst change every 30 days, one set assuming a change every 60 days. Proceed until No. 9 reaches a minimum.

This figure of the cost per pound of product is plotted against the interval between catalyst changes. This gives a graph similar to that shown in Fig. 4.

The minimum point on this curve is the optimum catalyst life for the most economical production with regard only to the operation of the catalytic step.

One additional variable must be considered. Since changing out the catalyst requires taking the catalytic units off stream, a production loss necessarily results. Therefore, the total possible yearly production—if the catalyst were changed at the given time interval—is computed. This curve is plotted on the same graph with the optimum cost curve (Fig. 4).

The most economical production with regard to the catalyst area is not the maximum production. If, however, a desired production rate is chosen, the optimum catalyst life—and therefore optimum cost for that production rate—may be determined from the graph.

An economic balance may be calculated for any plant equipment or material exhibiting a decline in performance as a function of time. This approach in the preparation of maintenance schedules will give you a more efficient plant operation.

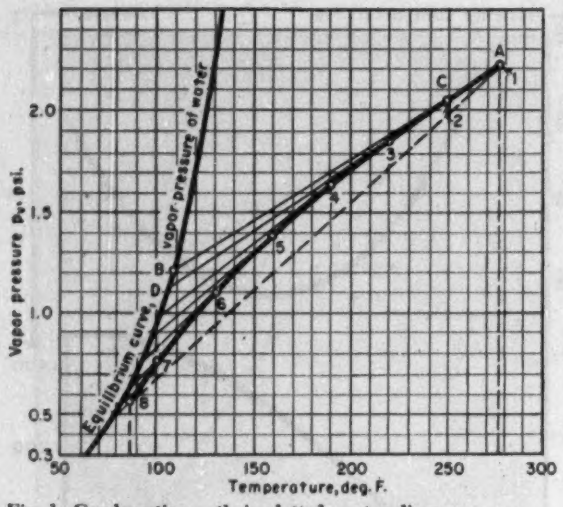


Fig. 1—Condensation path is plotted on t-p diagram.

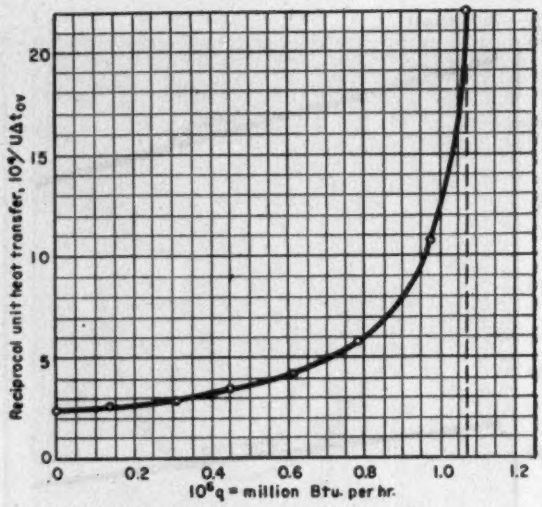


Fig. 2—Graphical integration shows heat transfer area.

Design of Cooler Condensers for Vapor-Gas Mixtures—II

Part I, in April, gave a new general method of design for cooler condensers in which the condensation path is found graphically. Here the method is applied to a typical design problem.

G. H. BRAS

In the first part of this article (April 1953, p. 223) we discussed the development of a general design method for cooler condensers which operates successfully whether or not the vapor-gas mixture remains saturated during condensation. It is also applicable when the initial mixture is not saturated. The method applies similarly to the design of other sorts of equipment where simultaneous heat and mass transfer occurs. Part I developed the necessary mathematical expressions, among them an equation which permits the graphical point-to-point determination of the temperature and partial vapor pressure of the gas vapor mixture as it passes through the condenser. Generally six to ten such points on the *t–p* diagram are required. Finally, by the calculation of the quantity of heat transferred in each step, we can apply graphical integration to discover the total required heat transfer area.

G. H. BRAS, *chemical engineer of Weert, Netherlands, has used the method described here successfully under a wide variety of conditions. Last month he developed the method, now he shows it in use.*

AMMONIA OXIDATION CONDENSER

A tubular cooler condenser is to be designed for converter gases in an ammonia oxidation plant. The converter gases have been pre-cooled in a boiler and other heat exchangers, and are further cooled down in the cooler condenser from 278 to 85 deg. F. Cooling water is available at 67 deg. F. In coolers of this type, it is essential to keep the contact of converter gases and condensed water as short as possible, to avoid the formation of excessive amounts of nitric acid in this part of the plant. For this reason the gases flow downward inside of the tubes, with relatively high velocity. Cooling water flows countercurrent over baffles outside of the tube bundle. If the increase in cooling water temperature is kept relatively small, the driving forces for both heat and mass transfer are increased. Hence both the dimensions of the cooler and the time of contact of the converter gases with the condensed water are reduced. The most economical increase of water temperature can be found by comparing the costs of cooling water and power, against the cost of stainless steel required for the cooler, including such items as depreciation. However, other considerations, such as the maximum obtainable nitric acid strength of the plant, may play an important role.

Although we may find that a different number of tubes will be needed if the length should be impractical, as a start we shall assume a hexagonal tube bundle of 1-in. O.D. × 0.87-in. I.D. stainless steel tubes, arranged in 1¾-in. triangular pitch, with 15 tubes along the diagonal. That gives a total of 169 tubes, in a shell of 28 in. di-

NOMENCLATURE

A	Area, sq. ft.
c	Specific heat at constant pressure, Btu./(lb. deg. F.)
C	Sutherland constant
D_v	Diffusion coefficient, ft.²/hr.
G	Mass velocity, lb./(hr. ft.²)
h	Heat transfer coefficient, Btu./(hr. ft.² deg. F.)
h_c	Heat transfer coefficient for condensate, Btu./(hr. ft.² deg. F.)
h_{comb}	Combined heat transfer coefficient for cooling water film, tube wall, scale and dirt films, and condensate film, Btu./(hr. ft.² deg. F.)
h_d	Heat transfer coefficient of dirt and scale, Btu./(hr. ft.² deg. F.)
h_g	Heat transfer coefficient in gas film, Btu./(hr. ft.² deg. F.)
h_t	Heat transfer coefficient of tube wall, Btu./(hr. ft.² deg. F.)
h_w	Heat transfer coefficient of cooling water, Btu./(hr. ft.² deg. F.)
j	Heat and mass transfer factor, Eqs. (2) and (3) (from *Ind. Eng., Chem.* 26, 1183, 1934, Fig. 2)
k	Thermal conductivity, Btu./(hr. ft.² deg. F. per ft.)
K'	Molecular mass transfer coefficient, lb.-mole/(hr. ft.²) per unit pressure
M_m	Molecular weight of gas-vapor mixture (average)
p_{gf}	Log mean partial pressure of non-condensible gas in the film, lb./in.²
p_g	Partial pressure of vapor in main bulk of the gas-vapor mixture, lb./in.²
q	Total heat transferred, Btu./hr.
t_c	Temperature of condensate at gas-liquid interface, deg. F.
t_g	Temperature of main bulk of gas-vapor mixture, deg. F.
t_w	Temperature of cooling water, deg. F.
Δt	Temperature drop through gas film, deg. F.
Δt_{ov}	Overall temperature drop between gas-vapor mixture and cooling water, deg. F.
Δp	Pressure drop through gas film, lb./in.²
T	Absolute temperature, deg. K.
U	Overall heat transfer coefficient, Btu./(hr. ft.² deg. F.)
ρ	Density, lb./ft.³
λ	Latent heat of condensation, Btu./lb.
μ	Viscosity, lb./(hr. ft.)
Pr	Prandtl number = $\mu c/k$
Re	Reynolds number = DG/μ
Sc	Schmidt number = $\mu/\rho D_v$

ameter which may be enlarged at the ends for attachment of the tube sheets. Baffle spacing will be 2 ft.

Assume that the entering mixture consists of NO, 22.55; O_2, 23.38; N_2, 200.75; and H_2O, 43.82 lb.-moles per hr. The following are the quantity and vapor pressure relations at inlet and outlet:

	Lb.-Mole per Hr.	V. P., Psia.
Inerts, in	246.68	12.487
H_2O, in	43.82	2.213
Total, in	290.50	14.700
Inerts, out	246.68	14.139
H_2O, out	9.77	0.561
Total, out	256.45	14.700
H_2O cond	34.05	——

HEAT TRANSFERRED

The necessary heat transfer to cool the mixture and condense a part of the water vapor can be determined as the difference in enthalpy of the mixture at 278 and at 85 deg. F. Using molal heat content of the gases, the heat content of the entering mixture is: 246.68 × 7.0 × (278 − 32) = 424,000 + 43.82 × 8.4 × (278 − 32) = 90,800 + 43.82 × 18 × 1,073.2 = 846,500, or a total of 1,361,300 Btu. per hr. Similarly, for the leaving gases, the heat content is: 246.68 × 7.0 × (85 − 32) = 90,700 + 9.77 × 8.4 × (85 − 32) = 4,300 + 9.77 × 18 × 1,073.2 = 188,900, or a total of 283,900 Btu. per hr. Hence, the heat to be transferred to the cooling water is 1,361,300 − 283,900 = 1,077,400 Btu. per hr. If we assume an increase in cooling water temperature of 6.2 deg. F., then the cooling water rate will be 1,077,400/6.2 = 172,000 lb. per hr.

HEAT TRANSFER COEFFICIENTS

The resistance of the condensate film, the metal tube, dirt and scale film, and the cooling water film can be considered as substantially constant. Therefore it will be convenient for further calculations to combine the heat transfer coefficients.

Condensate Film—Values for heat transfer coefficients of condensing steam in a vertical tube could be calculated with Nusselt's equation (*Zeitschrift Ver. deut. Ing.*, 60, 541-569, 1916). The resistance to heat transfer of the condensate film, however, is small as compared with the other resistances, and therefore a value of $h_c = 2{,}000$ will be assumed.

Tube Wall—Taking k for stainless steel as 14.8, the value of $h_t = 14.8 \times (12/0.065) = 2{,}730$ Btu./(hr. ft.² deg. F.).

Dirt and Scale—Scale formation in a cooler of this type, having a small increase of the temperature of the cooling water, will be limited. However, the effect of dirt may be appreciable owing to the large amount of cooling water. Moreover, cleaning of the outside of a bank of tubes is difficult, even if it can be done with diluted acid as in this case. Therefore, a safe value for the resistance of the dirt and scale film is selected as $h_d = 350$ Btu./(hr. ft.² deg. F.).

Cooling Water — Cooling water flow across the tube bundle between the baffles spaced at 2 ft. is through a free area of 28–15 = 13 in., by 2 ft. Hence $G = 172{,}000/(13/12 \times 2) = 79{,}500$ lb./(hr. ft.²). The physical properties of the cooling water at an average temperature of 70 deg. F. may be taken as $\mu = 0.982$ centipoises, and $k = 0.346$ Btu./(hr. ft.² deg. F. per ft.). Hence $\mathrm{Re} = 1 \times 79{,}500/(0.982 \times 2.42 \times 12) = 2{,}790$. Actually, in calculating the Reynolds number, the lower viscosity at the mean cooling water film temperature should be used. Our calculated value is therefore safe.

Using Chilton and Colburn's Fig. 2 (*Ind. Eng. Chem.*, 26, 1183, 1934), the value of j for Re = 2,790 = 0.015. Now from Eq. (2), $h = jcG/\mathrm{Pr}^{2/3}$, where $\mathrm{Pr} = c\mu/k$. Hence $h = 0.015 \times 1 \times 79{,}500/3{,}61 = 342$ Btu./(hr. ft.² deg. F.). Owing to the baffling effect we shall take only half of this value, or $h_w = 171$ Btu./(hr. ft.² deg. F.).

Combined Heat Transfer Coefficient—Calculating the combined heat transfer coefficient for the inside surface of the tubes, $h_{comb} = 1/[(1/2{,}000) + (0.87/0.935 \times 2{,}730) + (1/350) + (0.87/171)] = 113$ Btu./(hr. ft.² deg. F.).

Gas Film Coefficient—The weight of inert gas is 22.55 × 30 = 676 for the NO; 23.78 × 32 = 749 for the O_2; and 200.75 × 28 = 5,625 lb./hr. for the N_2, or a total of 7,050 lb./hr. of inerts. The weight of water vapor entering is 43.82 × 18 = 790; and its weight leaving is 9.77 × 18 = 175 lb./hr. Based on the properties of air, Table I has been prepared to show the conditions in the gas film at the entrance and outlet of the cooler. The values of h_g and $K'p_{gf}$ have been calculated from Eqs. (2) and (3) in Part I. The value of the diffusion coefficient D_v has been calculated from Arnold's equation (*Ind. Eng. Chem.*, 22, 1091, 1930), $D_v = D_{v_0}T^{3/2}/(T + C)$, where T = deg. Kelvin and C is the Sutherland constant for the system air-water vapor = 250. $D_{v_0} = 0.766$

ft.²/hr. at 273 deg. K. As can be seen from Table I, the values for h_g and $K'p_{gf}$ show a decrease at lower temperatures in the cooler.

In as far as this example has been given only to show the application of the new design method more clearly, an average value for both transfer coefficients will be taken for further calculations. Moreover, an average cooling water temperature of 70 deg. F. has been taken. It has further been assumed that negligible heat is developed by the oxidation of NO to NO_2 in the condenser.

However, if the design calculations require a closer approach, the values for h_g, $K'p_{gf}$, t_w, and the degree of oxidation of NO to NO_2 should be calculated from point to point.

REQUIRED SURFACE AREA

Our first step in determining the the point-to-point condensation path in Fig. I is to apply Eq. (1):

$$U \Delta t_{ov} = h_g (t_g - t_i) + K' M_v \lambda (p_v - p_i) = h_{cond} (t_g - t_w) \quad (1)$$

to the entrance conditions of the cooler, or $10.4(278 - t_i) + 1.78 \times 18 \times \lambda (2.213 - p_i)/p_{gf} = 113 (t_i - 70) = U \Delta t_{ov}$. By trial and error we find the equation is satisfied by: $t_i = 107.7$ deg. F., $p_i = 1.205$ psi., $p_{gf} = 12.99$ psi., $U \Delta t_{ov} = 4{,}260$ Btu./(hr. ft.²), $\lambda = 1{,}032$ Btu./lb.

In the t-p diagram (Fig. 1), the points (t_g, p_v) and (t_i, p_i) are represented by the points A and B, respectively. The cotangent to the operating line can then be calculated from Eq. 16:

$$\frac{dt}{dp} = \frac{p_{gf}}{(P-p)} \cdot \left(\frac{k}{c_p D_v}\right)^{2/3} \cdot \frac{\Delta t}{\Delta p} \quad (16)$$

as $dt/dp = (12.99/12.487) \times 0.91 \times (\Delta t/\Delta p) = 0.95 (\Delta p/\Delta t)$. For convenience the factor 0.95 has been taken as unity, making the cotangent to the operating line a straight line connecting the point A and B. As discussed in Part I, in other cases the value of the factor might deviate greatly from unity, and then the proper line for dt/dp should be drawn in the t-p diagram. The straight line in the t-p diagram may be followed over a short distance only, thus giving the second point, C. In this case, the line is followed until a temperature of 250 deg. F. is reached, corresponding with a vapor pressure of 2.047 psia.

Solving Eq. (1) for the conditions at point C, another temperature for the condensed water at the tube wall can be found by trial and error, and the procedure repeated. In this way, the condensation path is calculated from point to point. For this case eight points have been taken. In other cases, more or fewer points may be required, dependent on the curvature of the operating line and the degree of accuracy required. The results of these graphical computations are shown in Table II. In the last column, q, the total heat transferred, has been given. As the temperature and composition of the gas-vapor mixture are determined by graphical step-by-step procedure in the t-p diagram, the total heat transferred can be calculated by a heat balance.

The area required for the cooler condenser can now be found by a graphical integration of Eq. (18), as in Fig. 2. The values of $U \Delta t_{ov}$ are plotted against q, and the area under the curve, representing the required tube area for the cooler, can be determined by common methods. In this case 561 sq. ft. of tube area (inside) is required. The total length of the cooler tubes would then be $561/[169 \times (0.87 \times \pi \times 12)] = 14.6$ ft.

Table I—Gas Film Conditions

Factor	Entrance	Outlet
Deg. F	278	85
G	11,200	10,320
μ	0.023	0.019
Re	14,600	16,300
M_m	27.0	28.1
c	0.245	0.240
k	0.0178	0.0139
Pr	0.767	0.794
$(Pr)^{1/3}$	0.840	0.855
D_v	1.68	0.94
Sc	0.661	0.689
$(Sc)^{1/3}$	0.760	0.781
ρ	0.0501	0.0710
h_g	10.8	10.0
$K'p_{gf}$	1.91	1.65
$k/c_p D_v$	0.863	0.808
$(k/c_p D_v)^{2/3}$	0.908	0.911
j	0.0035	0.0035

Table II—Factors Determined From Graphical Computation

Factor	Point No. (Fig. 1) 1	2	3	4	5	6	7	8
t_g, deg. F	278	250	220	190	160	130	100	85
p_v, psi	2.213	2.047	1.851	1.631	1.381	1.092	0.760	0.561
t_i, deg. F	107.7	105.3	101.5	97.0	92.0	86.0	78.2	74.2
p_i, psi	1.205	1.110	0.983	0.850	0.726	0.600	0.476	0.420
$U\Delta t_{ov}$	4,295	3,900	3,500	2,990	2,430	1,770	945	462
Δt_{ov}	208	180	150	120	90	60	30	15
U	20.60	21.67	23.33	24.90	27.00	29.50	31.50	30.82
$10^3/U\Delta t_{ov}$	2.31	2.57	2.86	3.35	4.11	5.65	10.6	22.1
Moles H_2O remaining	43.82	40.00	36.60	30.81	25.60	19.80	13.45	9.77
Moles H_2O condensed	.....	3.82	3.40	5.79	5.21	5.80	6.35	3.68
p_{gf}, psi	12.98	13.12	13.27	13.45	13.64	13.85	14.08	14.21
λ, Btu	1,032	1,034	1,035	1,038	1,041	1,044	1,048	1,052
q, M Btu	.....	138.9	309.9	454.7	619.5	792.4	977.6	1,077.4

DISCUSSION OF RESULTS

It is evident from Table II that the overall heat transfer coefficient U increases during cooling and condensation. If the values for the heat and mass transfer coefficients for the gas film are calculated from point to point, the increase of U is maintained, although it is a little less pronounced. In that connection, it may be remembered that Colburn and Hougen (*Ind. Eng. Chem.*, 26, 1178, 1934) have shown a case in which the overall heat transfer coefficient U decreased during cooling. Both mass velocity and partial vapor pressure changed greatly during cooling, due to condensation. The overall temperature drop Δt_{ov} varied between a maximum of 49.2 somewhere between entrance and outlet of the cooler, and a minimum of 15 deg. C. at the outlet, the ratio being about 1:3.

In the example given here, the mass transfer coefficient and partial vapor pressure of the inerts do not show so much variation, but the overall temperature difference Δt_{ov} falls from 208 deg. F. at the cooler entrance to 15 deg. F. at the outlet—a ratio of about 1:14. This explains the increasing overall heat transfer coefficient U for this case. It is evident from this example, and that given by Colburn and Hougen, that the prediction of the overall heat transfer coefficient U is not a simple matter, even if the individual heat and mass transfer coefficients are nearly constant, as has been assumed in the example given.

Although the design method presented here is of special interest for the calculation of cooler condensers, it is obvious that the principles may be applied to the design of other equipment in which simultaneous heat and mass transfer take place. Such equipment would include humidification, drying, evaporation, cooling towers, and the like.

Hard rubber lined chlorine gas coolers



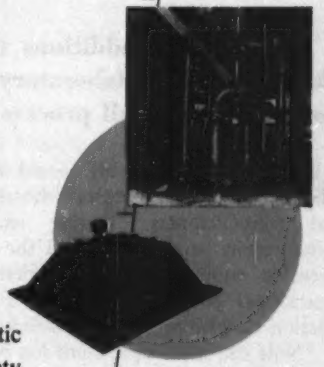
don't give CORROSION an inch . . .

. . . IT MAY TAKE A mile

Ever stop to think how much of your plant could be taken out of service by a pinhole failure in a vital fitting, tank, or valve? The average pump failure, for example, was found to cost $125 according to one survey. We know of cases where more than a mile of piping and equipment has shut down when corrosion struck one small, unprotected spot.

In Ace hard rubber protected equipment there are no loopholes for pinholes. The protection you buy gets 20 rigid inspections, developed through 100 years of experience with this finest of corrosion-resistant materials. In one test, a piece from the same batch of rubber, bonded and vulcanized at the same time as the lining, goes to the laboratory for complete breakdown analysis just to make *sure*.

Hard rubber pipe and fittings handling zinc chloride



Special chlorine cell cover has high heat and chemical resistance

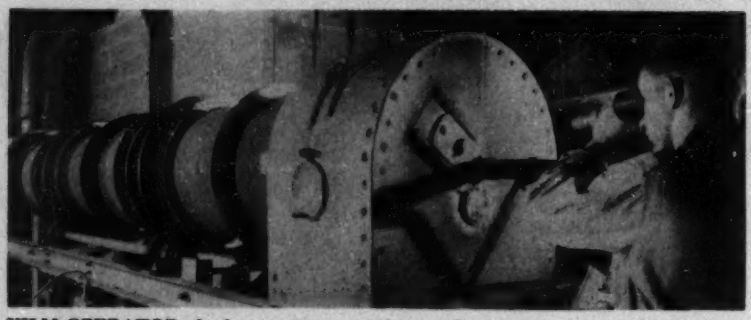
Many types of Ace rubber and plastic materials are available in a wide variety of standard or special equipment for complete chemical processing, storage or circulating systems. Write for bulletins.



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NEW PROCESSING EQUIPMENT



KILN OPERATOR checks temperature at firing end with optical pyrometer.



BALL MILL is set up to operate in closed circuit with a classifier.

Process Lab Facilities Grow

Recent additions to equipment facilities in a well known process laboratory broaden its scope as a service organization to all process industries.

"Come one, come all" could well be the motto of the process laboratory at Allis-Chalmers. During recent years many people have used the extensive equipment and experienced personnel of this non-profit organization to solve processing problems.

Now still more equipment has been added to an already impressive array. Among the latest units are a 15 ft. by 26 in. rotary kiln, a 12 ft. by 18 in. rotary dryer, an 8 ft. by 30 in. peripheral discharge rod mill, a ball mill classifier circuit, a 3 ft. by 4 ft. rotary drum filter and a magnetic separator.

All this equipment is set-up with flexibility for pilot plant operation a primary consideration. Take the rotary kiln for example. The cylindrical steel shell with three flanged sections has an over-all length of 15 ft. 4 in. and a diameter of 26 in. Shell lining is 60 percent alumina refractory brick giving an effective inside diameter of 16.25 in.

Kiln mounting is an adjustable frame which permits the slope to be varied at will. A vari-pitch drive allows variation of the rotational speed. Temperature measurements are given by thermocouples embedded in the refractory lining and by an optical pyrometer at the firing end.

Material is fed into the kiln by a 6 in. diameter screw feeder. Discharge drops into a hopper which can be unloaded at will by a sliding gate.

The rotary dryer can be mounted on the same frame as the kiln and is fired in a similar fashion by propane gas. Thermocouples projected through the dryer shell give temperatures.

On the rod mill installation a d.c. drive provides variable speed. The mill can be operated with diaphragm, overflow, end peripheral or center peripheral discharge. Rods charged to the mill range in size from 1 to 2½ in.

Although Allis-Chalmers as an equipment manufacturer is primarily interested in selling equipment the process laboratory operates as separate, fact finding, unbiased organization. All work is conducted on a confidential basis and the client is entirely free to satisfy ultimate equipment requirements wherever he wishes.

Prospective users of these facilities will be interested in the types of investigative work that are carried out here. Specific samples of material can be tested by a customary known process for the purpose of recommending proper size and modification of processing machines. Materials can be processed by several different methods to determine the most suitable method and equipment.

More extensive investigations aim at developing and testing new processes and new combinations and variations of existing processes. Also original research on practical problems points to increasing general or specific technical knowledge, particularly in the field of comminution.

A round-up of the pilot plant equipment shows apparatus for crushing, grinding, screening, sizing, washing, flotation, gravity separation, rotary kiln tests, and a hearth type roasting furnace for pyrometallurgical studies. Sample sizes can range up to 10 tons or more.

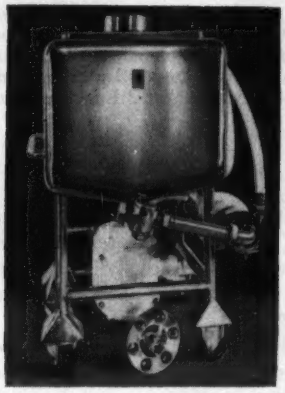
Among the studies which have been done are economic recovery of cottonseed oils and wood waste; rod mill and ball mill grindability tests; crushing studies in jaw, gyratory, roll and impact crushers; drying of slurry and filter-cake; filtering and settling area requirements; flaking of litharge and pigments; paper pulp preparation; drying phosphate slurry with chain dryer; grinding insecticides to extreme fineness; and disposal of tar and oil refinery waste sludge.—*Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.*

Equipment Cost Indexes

(Marshall & Stevens Indexes, 1926 = 100)

Industry	Mar. 1952	Dec. 1952	Mar. 1953
Average of all.....	180.2	180.8	180.7
Process Industries			
Cement mfg.	172.8	173.0	172.7
Chemical	180.8	181.4	181.1
Clay products	167.8	168.0	167.7
Glass mfg.	170.9	171.4	171.1
Paint mfg.	174.1	174.7	174.4
Paper mfg.	174.4	175.0	174.7
Petroleum ind.	177.2	178.1	177.8
Rubber ind.	179.6	180.5	180.2
Process ind. avg....	178.2	178.9	178.6
Related Industries			
Elec. power equip...	182.4	183.3	183.0
Mining, milling	181.5	182.4	182.1
Refrigerating	200.3	201.2	201.0
Steam power	170.0	171.0	170.7

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering**, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering**, March 1953, pp. 220, 221.



IN BRIEF—A capsulated listing of this month's newsworthy equipment.

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Processing Equipment		
Process Laboratory	Has added equipment to broaden service	242
High Speed Mixer	Rapidly blends liquids and powders	243
Safety Lock	Prevents premature opening of pressure vessels	243
Ultrasonic Emulsifier	Produces emulsions more effectively	243
Automatic Mixer	Designed and built for pilot plants	244
Filter Media	Constructed of rigid refractory material	244
Sulfonation Plant	Built and shipped as a packaged unit	244
Hammer Mill Screen	Can be removed without stopping mill	244
Food Freezer	Incorporates automatic continuous conveyor	244
Heating & Cooling Equipment		
Graphite Exchangers	Are redesigned for lower cost per unit area	246
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Magnetic Base	Holds dial and gage indicators	248
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Sprocket Bushing	Eliminates need for reboring stock sprockets	248
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Vacuum Pump	Is modified to improve operation and maintenance	253
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Double Suction Pump	Fits compact space, has interchangeable mount	254
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Hand Truck Trailer	Used either as hand truck or train trailer	257
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Materials of Construction		
Plastic Tank	Now fabricated by new method for lower cost	260
Pump Housing	Protected by porcelain for deep well use	260
Structural Plastic	Used for ducts without the use of molds	261
Tank Liners	Of plastic are custom fabricated and leakproof	261

High Speed Mixer Blend Liquids and Powders

Rapid blending of liquids and powders in proportions up to 1 to 1 are provided by the Norman mixer. Mixing action is accomplished by a six-fluted agitator direct driven by a 1,750 rpm. motor. Either stationary or mobile units can be furnished in capacities of 8, 15, 25, 50 and 75 gal. Construction is all stainless steel.—*Cherry-Burrell Corp., 427 West Randolph St., Chicago 6, Ill.*

Door Safety Lock Guards Pressure Vessel

A new door lock for pressure vessels makes it impossible to carelessly open or close a vessel door. Completely automatic, the lock prevents admission of steam until the vessel door is completely closed and locked; and prevents the door from being opened until pressure in the vessel has been reduced to 10 in. of water or less.

Sensing element is mounted on the shell of the vessel so that it receives full internal pressure. This element operates dependably at less than 10 in. of water pressure, yet withstands operating pressures up to 150 psi.

In operation, the sensing element controls the diaphragm-operated lock which is mounted on the door ring, locking the door by means of a stop bolt. In turn, the position of the stop bolt controls operation of the safety air valve mounted on top of the diaphragm operated lock. The safety air valve permits or prevents passage of air to the vessel control instrument. This instrument operates steam inlet and blowdown valve on the vessel.—*Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.*

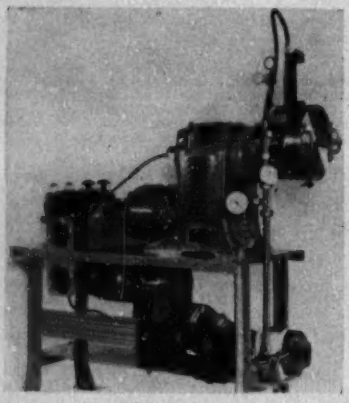
Ultrasonic Emulsifier Shows High Efficiency

Impingement of a liquid jet on a metal blade in the Rapisonic emulsifier produces the ultrasonic vibration required for emulsification. Jet and blade are enclosed by a resonance bell which concentrates the local ultrasonic effects.

Emulsification takes place when cavities are produced by the blade oscillating at about 22 kilocycles. Collapse of these cavities produces instantaneous local pressures on the order of 30,000 psi. This is said to be the basis of the machine's efficiency in emulsifying. *(Continued)*

So effective is the machine that in most cases the amount of emulsifying agent can be reduced or left out altogether.

Output of the portable unit is 480 gal. per hr. A clamp-mounting provides easy installation on the side of existing mixing vessels. All parts in contact with liquids are of stainless steel. Frequency of blade vibration is easily adjusted.—*Ultrasonic Co., 198 Pacific St., Newark, N. J.*



Automatic Mixer Fills Pilot Plant Need

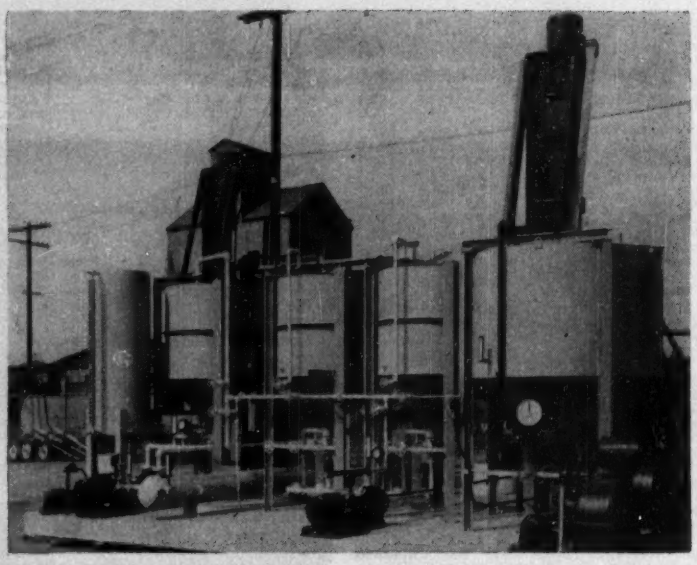
Model 10M-3 of the Oakes continuous automatic mixer has been designed and built especially for pilot plants and smaller production units. This model has about one-half the capacity of the standard 14M-5 mixer. Both units are made for continuous intimate mixing of pumpable material. The mixing heads on all parts within the product area are made of stainless steel.—*The E. T. Oakes Corp., Commack Rd., Islip, N. Y.*

Rigid Filter Media Give High Flow

Calcined refractory filter media is now being made with a total pore volume of approximately 50 percent. The material is said to give flow rates with low-pressure drop despite a smaller pore size range than usual.

Furnished in square and rectangular plates or tubes for 4.5 in. O. D. x 36 in. length maximum, the filter media can be used for various acids and mild caustic filtration, as well as gas filtration.

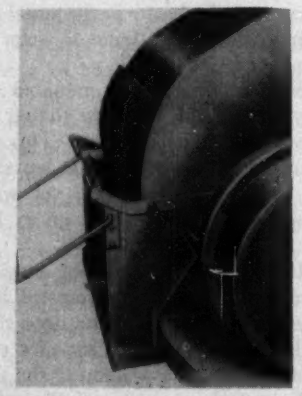
A similar material made of porous carbon is suitable for filtering caustic and hydrochloric acid at any concentration and temperature.



SULFONATION PLANT COMES IN A PACKAGE

The purchaser of this packaged sulfonation plant only has to connect his main power feed line and interconnecting piping before starting production. Before shipment, this particular plant test-produced two batches of sulfonated material. Packaged plants of this type are said to save considerable installation expense and time. Also, many start-up headaches are eliminated.—Industrial Engineers, Inc., 817 East 59th St., Los Angeles 1, Calif.

A slightly flexible, porous-thermoplastic filter medium 3.5 mm. thick, is supplied in sheets up to 40 in. square and tubes up to 40 in. long. Pore size range is 15 microns. Material is resistant to all dilute acids and alkalies and petroleum products up to 65 deg. C.—*Filtros, Inc., 3343 Kuppinger St., East Rochester, N. Y.*



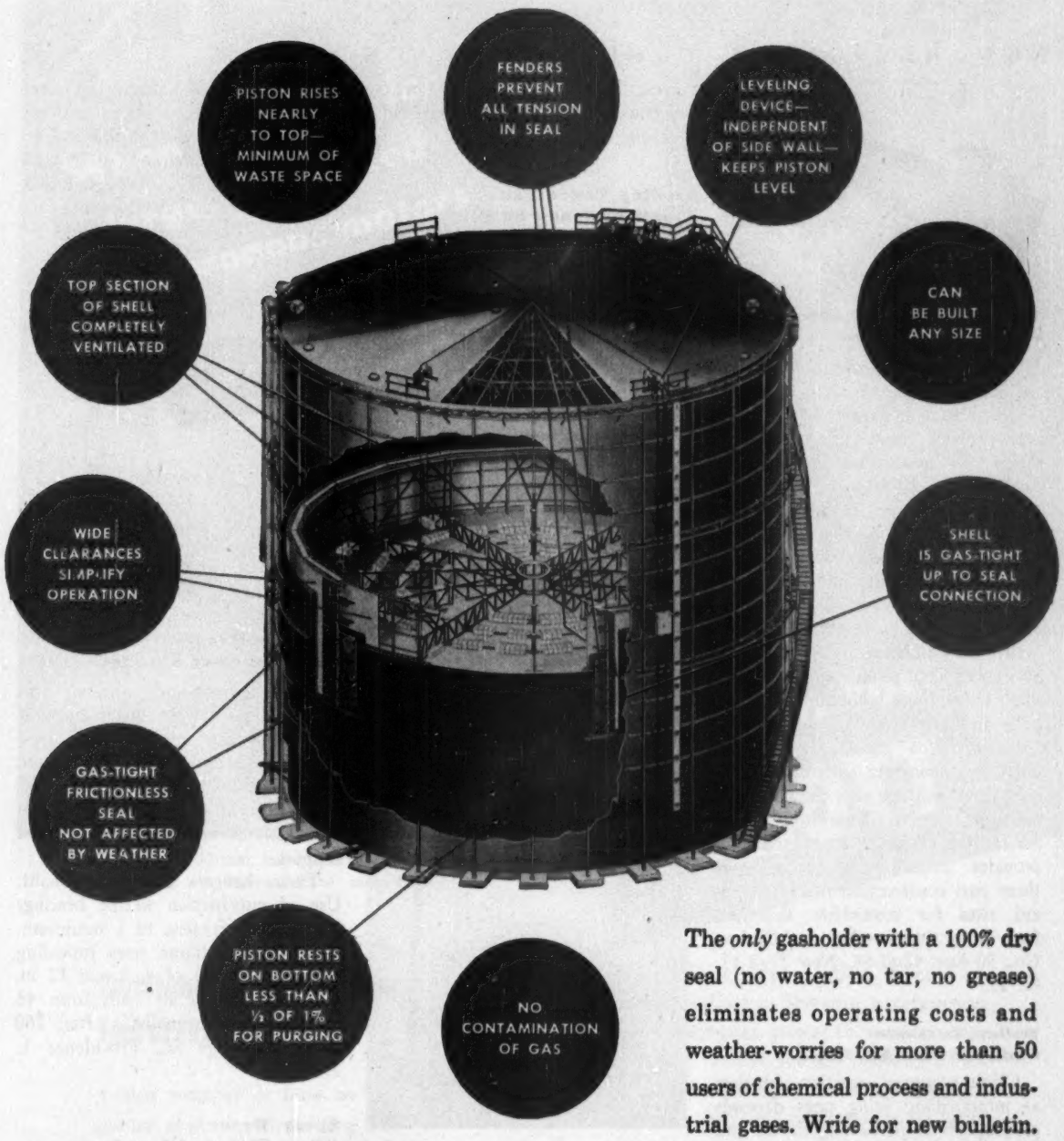
Hammer Mill Screen Removed Without Stopping

Screen replacements in a few seconds, during operations, are now possible with a new hammer mill design. Without stopping the mill or opening the cover the screen is easily withdrawn and replaced, sliding smoothly on non-binding leak-proof grooves in the case.

There is no need to remove any other parts. A lever lock is merely tripped and a wing nut loosened to release the hand guard. Utmost safety against exposure to the whirling hammers is provided by the guard it is said.

A complete range of sizes, from 20 to 125 hp., is available in belt-driven and direct-connected models. Construction is all-welded steel.—*Schutte Pulverizer Co., 27 Clyde Ave., Buffalo 15, N. Y.*

New continuous food freezer equipment incorporates the first fully automatic continuous conveyor system for rapid freezing of packaged foods in a wide variety of shapes and sizes. A variable speed drive permits the conveyor to be synchronized with the plant production rate. Holding time in the freezing zone can be varied from 40 to 120 min. —*The Girdler Corp., 224 East Broadway, Louisville 1, Ky.*



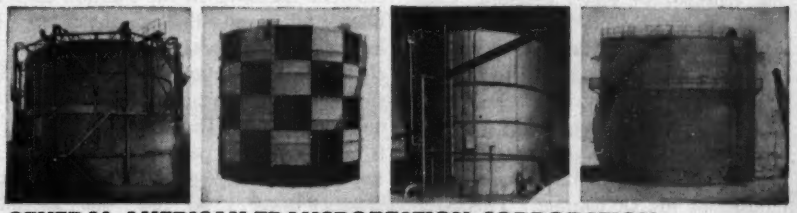
The *only* gasholder with a 100% dry seal (no water, no tar, no grease) eliminates operating costs and weather-worries for more than 50 users of chemical process and industrial gases. Write for new bulletin.

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New Graphite Exchangers Feature Lower Cost

Karbate impervious graphite standard heat exchangers have been redesigned to give lower cost per unit area of heat transfer surface. New series 310A and 90A replace, respectively, old series 240A and 70A.

Features included in the new units are completely removable impervious graphite tube bundles with stainless steel baffles, separate and removable impervious graphite fixed and floating end covers, interchangeable single end multi-pass construction, rugged type SN cover connections and oversize shell connections with built-in vapor belts and impingement plates.

Series 310A standard heat exchanger allows for interchangeable one, three and five pass use in standard unit sizes available from stock. Series 90A standard heat exchanger provides interchangeable one and three pass construction in two standard sizes for immediate shipment from factory stock.—*National Carbon Co., 30 East 42nd St., New York 17, N. Y.*

Boiler Pressure Controls Fuel-Air Ratio

Clean economic operation of boilers at intermediate firing rates depends on properly proportioning the air and fuel ratio to the burner. In the Powermaster boiler a pressure control potentiometer positions the damper motor which adjusts the fuel valve and air damper according to steam demand as reflected by boiler pressure. Control is effected at all intermediate points from 100 percent full load firing rate down to 30 percent of full load.

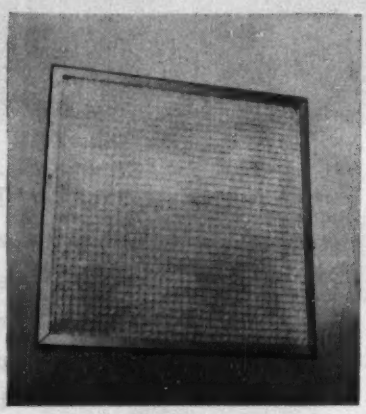
The operating mechanism is an adjustable cam which positions the fuel valve and an adjustable linkage which positions the air damper. This combined movement of fuel valve and air damper ensures a flue gas with correct CO_2 content and temperature under varying load conditions. — *Orr & Sembower, Inc., Morgantown Rd., Reading, Pa.*

Cooling Tower Fan Floats Free and Easy

Resilient blade mounts in the Class 7000 Type C cooling tower fans eliminate bending stresses at the root of the blade. This permits the blade to find a position during rotation where centrifugal force balances out the forces of lift and drag. Shocks imparted by turbulent air merely flex the joint without creating undue stress.

The fan can be furnished with from two to eight blades in diameters up to and including 24 ft. Design details provide uniform air velocity from hub to tip. Simultaneous pitch adjustment of all blades is secured merely by rotating one nut.

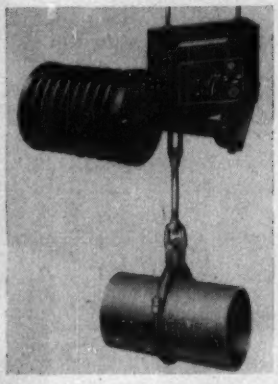
Fans are furnished in two basic sizes: Series 48 and Series 72 (number indicates hub diameter expressed as inches).—*The Moore Co., Marceline, Mo.*



Plastic Air Filter Traps Dust by Static

Airborne pollen, soot and dust are trapped and held by electrostatic charges present on the surface of polyethylene filaments in the Pliotron air filter. Air passing through the filtering element produces electrostatic charges in the plastic mat. These electrostatic charges attract dust particles and hold them. The trapping action is said to be 400 percent more effective than obtained with ordinary filters.

Pliotron filters can be installed without modification of present forced air systems. The filter is cleaned in a few minutes by gently rinsing in clear water and may be replaced without drying. Elements are available in 1-in. thickness with dimensions of 16 x 20 in., 16 x 25 in., 20 x 20 in., and 20 x 25 in.—*Goodyear Tire & Rubber Co., Dept. 722, Plant 2, Akron, Ohio.*



Hot-Pipe Hanger Gives Constant Support

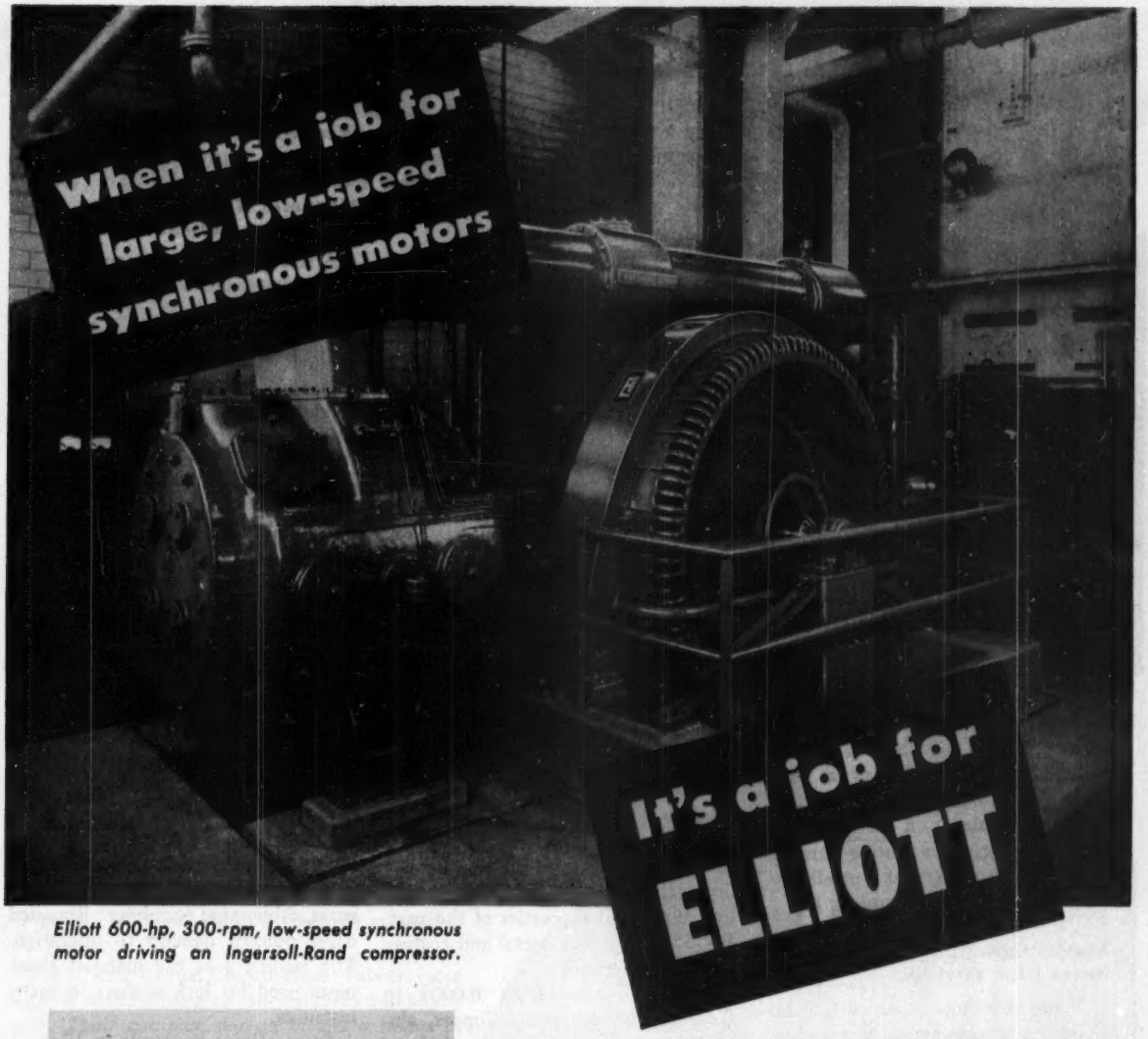
High temperature process and steam piping can be given constant support by the new Model R pipe hangers. An exclusive design feature permits 10% load increase or decrease by field adjustment of a single bolt without impairing constancy of support.

These hangers are non-resonant. Use of anti-friction needle bearings has reduced friction to a minimum. Three regular frame sizes providing maximum travels of 4, 8 and 12 in. will take care of all loads from 48 to 9,304 lb.—*Grinnell Co., Inc., 260 West Exchange St., Providence 1, R. I.*

Spray Dryer Offers Choice of Atomizers

Either centrifugal or nozzle atomizers can now be furnished by a single manufacturer of spray dryers. Greater operating flexibility attained allows the equipment to be used for a number of different products with widely varying characteristics. Savings in capital investment for equipment are thus realized.

Dryers are designed to permit free interchangeability between the two types of atomizers. Selection of proper type can be determined in the manufacturer's testing facilities.—*Bowen Engineering Co., North Branch 20, N. J.*



Elliott 600-hp, 300-rpm, low-speed synchronous motor driving an Ingersoll-Rand compressor.

Outstanding construction features:

- Mica wrapper or tape on slot portion of stator coils for long life.
- Large area starting winding joints resistance brazed with silver alloy for strength and high electrical and thermal conductivity.
- Fine workmanship throughout.

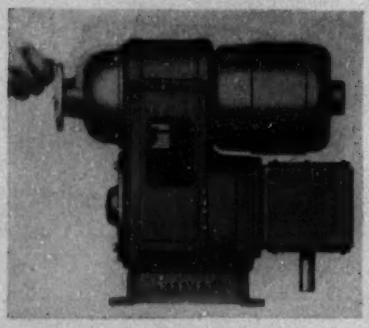
• Like all large Elliott motors, these motors are designed to fit the installation. Starting, accelerating, pull-in and pull-out torques, power factor correction and other important factors are all tailored to the requirements. And whether open or totally-enclosed, Elliott low-speed synchronous motors may be given a number of mechanical protection, cooling and mounting arrangements. Back of this design flexibility are the built-in ruggedness and efficient operational characteristics which combine to make these motors the perfect teammate for compressors, pumps, Jordans, rolling mills, ball mills, etc. For complete details and ready reference, write to Elliott Company, Ridgway, Pa., for the low-speed Synchronous Motor Bulletin.

ELLIOTT Company

RIDGWAY DIVISION

R3—6

FOR MOTORS 1-200 HP: CROCKER WHEELER DIV. AMPERE, N. J.



Right Angle Output Shaft On Variable Speed Drive

Recently added to the Vari-Speed Motodrive line is a fractional horsepower unit with right angle reducer. All fractional horsepower units in either vertical or horizontal models can be furnished with the right angle worm gear reducer for speed ratios from 2 to 1 through 10 to 1.

On horizontal units the output shaft drives up, down, or at right angles. Vertical models have the output shaft driving down or at right angles. This arrangement is expected to have advantages in many applications, permitting mounting arrangements heretofore not possible.—*Reeves Pulley Co., Columbus, Ind.*

Flame Cutter Saves Pipe Fittings

A new precision, flame cutting machine can rework, recondition and salvage all types of new and used welding ells, tees, flanges, reducers, etc. It is said the machine will cut ells to any angle, shorten ells, tees, flanges, and reducers; also recut and bevel used ells, tees, swedges and returns.

Mounted on a sturdy steel base, the flame cutter has a unitized control panel and gas control valve. The table which holds the fitting revolves in either direction at speeds varying from 0 to 5 rpm. An adjustable degree plate permits the fitting to be cut at any desired angle. Cuts are extremely clean, eliminating the need for cleaning or hand fitting.—*Vernon Tool Co., Ltd., 1101 South Meridian Ave., Alhambra, Calif.*

Flexible Metal Conduit Approved for Wet Areas

Flexible electric conduit Type UA is said to be the first of its kind to meet Underwriters' Laboratories approval for use in wet locations. Featuring a flexible metal core protected by a tough extruded synthetic covering, this conduit protects wiring against moisture, oil, dirt, chemicals and corrosive fumes.

Light and flexible in nature, Type UA can be cut to required length and bent easily as required. Underwriters' approved fittings are available for use with the conduit. Available sizes range from ⅜ to 1¼ in. I.D.—*The American Brass Co., Waterbury, Conn.*

Flame-Plating Protects Wear Parts

Powdered metals such as tungsten carbide are now being applied to base metal surfaces to help solve frictional and abrasive wear problems. Tests to date indicate that flame-plated tungsten carbide coatings have the desirable properties of sintered tungsten carbide while avoiding some of the limitations of the sintered form. These coatings equal or surpass sintered carbides for wear and abrasion resistance.

An outstanding feature of the process is that the base metal temperature does not exceed 400 deg. F. during the plating operation. Thus there is no possibility of warping or change in the physical properties of the part. Bond between base metal and coating is entirely mechanical.

Coatings range from 0.0005 to 0.020 in. in thickness. Copper, aluminum, magnesium have all been successfully used as base metals for coating by the flame-plating procedure.

Some of the parts being successfully protected by this method are shaft bearings, valve plugs, seat rings, and pump plungers.—*Linde Air Products Co., 30 East 42nd St., New York 17, N. Y.*

Gearmotor Delivers Slow-Speed Power

Gearmotors deliver power at speeds comparable to slow-speed motors by using reduction gears in combination with smaller, more efficient high-speed motors. The Type B single reduction gearmotor is a new offering in this line. This unit meets the mounting-limitation requirements peculiar to side entry agitators and mixers. It is also suitable for light-duty coupled-service applications such as fans and pumps.

Type B gearmotor is available in ratings from 1 to 30 hp., 780 to 420 rpm., AGMA Classes I and II.—*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*

Magnetic Base Holds Dial Indicators

A steady mount for gages and dial indicators is provided by a new magnetic base which holds securely on any flat or curved metal surface. The instruments are merely attached to the magnetic base, which is completely steady, enabling maximum accuracy of measurement to be obtained. The versatility of the base is such that it can be used not only with height gages and dial indicators, but also as a miniature chuck for small light precision work or on a long handle to retrieve metal parts from all sorts of plating baths. Another use is for holding work in position on surface layout plates.—*Main Electric Co., 1470 Main St., East Rochester, N. Y.*

Cable Clamps Are Made of Plastic

Electric cable clamps are now being made of non-inflammable Saran thermoplastic material. Since Saran is pliable, the clamp can be opened to any dimension for easy sliding over wires, cable, pipe or tubing. Rounded edges prevent damage to insulation. The resiliency of the material eliminates need for lock washers in many instances.

Saran clamps are made in 17 stock sizes ranging from ⅛ to 1¼ in.—*Holub Industries, Inc., Sycamore, Ill.*

Electric arc cutting-electrode is said to cut steel up to two and one-half times faster than standard electrodes. No oxygen, acetylene or other fuel gas is required. Electrode can be used on steel, stainless steel, iron, cast iron, copper and nickel, with either a.c. or d.c. current.—*Allstate Welding Alloys Co., Inc., 249 Ferris Ave., White Plains, N. Y.*

Sprocket bushing with a split tapered design makes it possible to use the same size sprockets on shafts from ¼ to 2½ in. in diameter. Use of the Shold-A-Grip bushing eliminates the need to rebore stock sprockets to fit existing shafts.—*Boston Gear Works, 14 Haywood St., Quincy 71, Mass.*

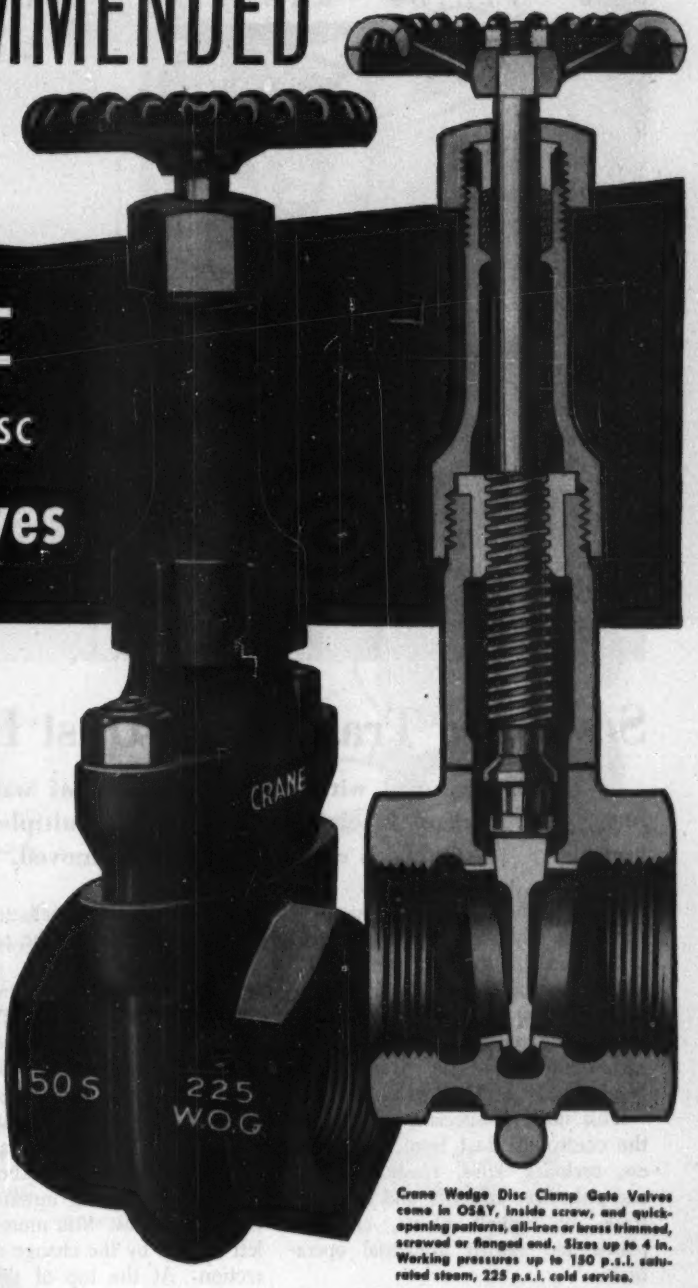
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for low cost service

CRANE

IRON BODY—WEDGE DISC

Clamp Gate Valves



Crane Wedge Disc Clamp Gate Valves come in OS&Y, inside screw, and quick-opening patterns, all-iron or brass trimmed, screwed or flanged end. Sizes up to 4 in. Working pressures up to 150 p.s.i. saturated steam, 225 p.s.i. cold service.

Low in first cost, as well as in upkeep... and look at their wide utility—

Use Crane Clamp Gate Valves for steam; hot and cold water; crude, fuel, and lubricating oil; air, gas, and gasoline service.

Also in food and chemical process industries for caustic solutions, alkalies, corrosive chemicals, and gases.

You'll find Crane Clamp Gate Valves extra rugged, with a strong reinforced body and husky stem. Their compact design means a better fit for more places... a saving on piping in many cases. And because of the simplified clamp construction, these valves enjoy wide favor where frequent cleanout is essential. The bonnet assembly and wedge disc lift out easily—the body stays in the line. Reassembling is no problem—the bonnet joint makes up tight and stays tight.

Wide choice of regular patterns, all-iron or brass trimmed. On inside screw all-iron valves, an improved self-draining bonnet prevents entrapment of line fluids in the bonnet—protects the threads, keeps the stem working smoothly. Send for Folder AD 1667 or ask your Crane Representative for full details.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

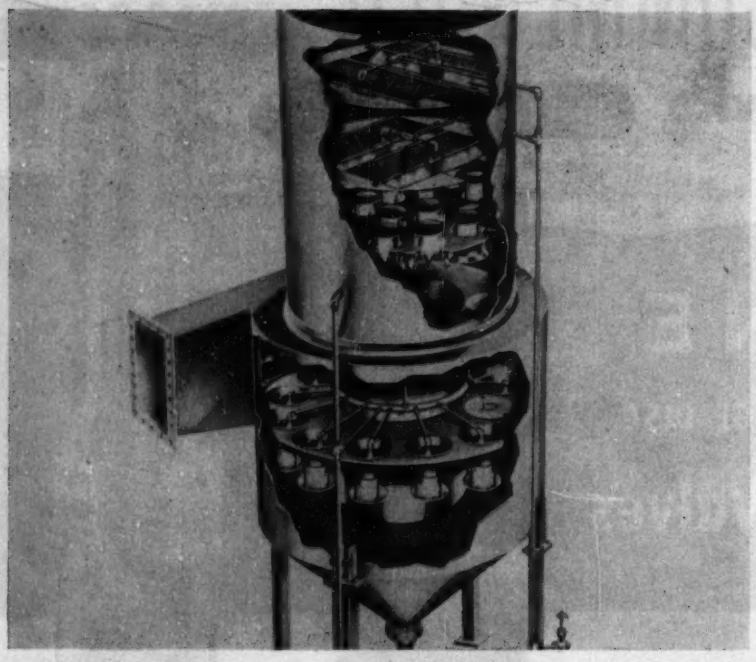
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VALVES • FITTINGS • PIPE • PLUMBING • HEATING



Scrubber Traps High Dust Load

Dust removal with a small quantity of water and low pressure drop is claimed for a new multiple action scrubber. Assembly is compact and easily moved.

High operating efficiency, even at extremely high dust loadings is said to be offered by the new type V "LP" multiple-action scrubber. Water use is kept to a maximum of approximately 2 gpm. at 40 to 50 psi. for each 1,000 cfm. of gas. Average draft loss is about 2 in. of water pressure.

This unit is especially adapted to the control of dust from rotary dryers, cyclones, kilns, roasters, mixers and pulverizer exhausts; and from the stacks of asphalt plants, chemical plants and similar industrial operations.

As the gas enters the unit it is subjected to centrifugal action which removes larger particles and pre-cools the gas. Directional and velocity control of the gas are attained by multiple scrubber throats. In turn division of the gas flow into smaller streams gives better scrubbing action.

Gas velocity is accelerated so that entrained solids impact upon impinger plates. A high velocity water jet also impinges on each of these plates. This wets the plate and breaks up the water into small droplets for efficient scrubbing of the solids from the gas stream.

After making downward passage through the first bank of throats the gas stream expands as it enters the lower expansion chamber. By this time the bulk of the solids has been removed and discharged as a slurry through the bottom drainage outlet.

From the lower chamber the gas flow reverses passing upward through the center stack. Still more solids are left behind by the change of flow direction. At the top of the stack is another expansion chamber where velocity is once more reduced.

At this point the gas passes through two more stages of multiple scrubbing throats to ensure maximum removal of smaller particles. If required, additional stages can be included for further recovery of sub-micron sizes.

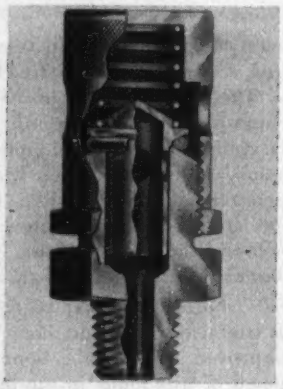
Final cleansing is accomplished by passing the gas through a section where it is contacted with water containing a wetting agent designated as compound M. Remaining low micron particle sizes and entrained mist are thereby removed.

A proportioning unit delivers the proper concentration of compound M solution to the last stage. Presence of the wetting agent in the slurry draining from the unit is said to improve the rate of water clarification in the sludge pond or settling tank. Thorough wetting of the solid particles makes them sink to the bottom at a faster rate. Clarified water can be recirculated where water supply is limited.

Scrubbers are built in various sizes for capacities ranging from 1,500 to 48,000 cfm. Physical size varies from approximately 15 to 33 ft. high.

Construction is ¼-in. steel plate, electrically welded. The unit is mounted on sturdy H-beam support legs. Each unit is built in two or more sections for ease of erection and dismantling.

Where corrosion is a problem suitable linings of corrosion-resistant metal can be installed. Companion flanges for both air inlet and sludge discharge connections are provided as standard equipment. — *Johnson-March Corp., 1724 Chestnut St., Philadelphia 3, Pa.*



Relief Valve Controls At Low Pressure

Adjustable and precise low-pressure control of safe gases is offered by the new 5400 relief valve. Valve can be furnished for relief pressures from 2 to 45 psi.

A standard O-ring seal is used in the pressure range from 2 to 6 psi. This seal is self-aligning between two conical seats of a poppet type valve. For higher pressures the O-ring is supplied with a metal back-up ring to

Get

something extra

when you buy

lead pipe and fittings

Quantity, size, type, physical composition . . . these are what you specify when buying lead pipe and fittings.

Do one thing more, however. Specify National and get certain extras . . . extras that take full advantage of lead's ability to withstand attack by corrosives.

For one example, when you specify National "Tubond" pipe and fittings, you get the corrosion resistance of lead combined with the strength of steel, in a virtually inseparable union of lining and casing. And the lead you get is a grade that Nature endowed with excellent acid-handling qualities — St. Joe Chemical Lead. You get equipment designed to handle acids under difficult conditions of temperature, pressure and vacuum. You get full flow-way. You get greater security against leakage, because of extra lead on flange faces.



Extras in design, in fabrication, in careful chemical composition. To get them make this specification: National!

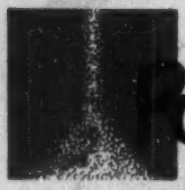


Lead pipe and fittings with a NATIONAL reputation

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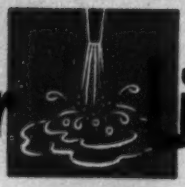


Powders

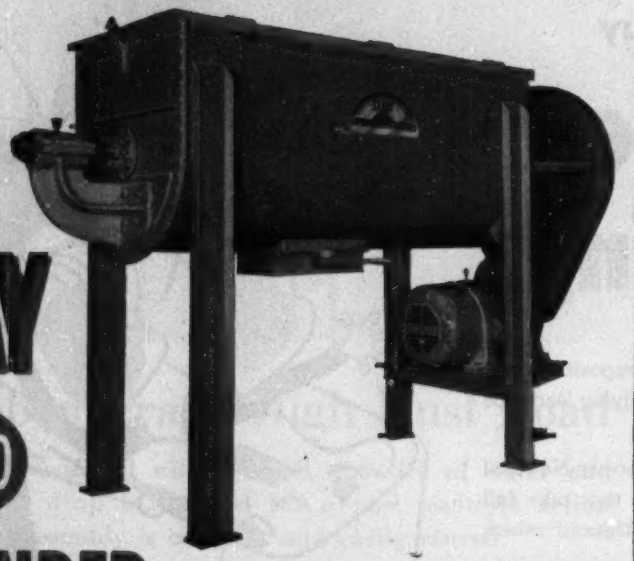


Pastes

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Liquids



DAY

D-10

BLENDER *does a finer, faster job!*

Whether you work with powders, pastes or liquids, you can depend on a DAY D-10 BLENDER to boost production. Scientifically designed agitators insure constant, thorough blending action. Sturdy outboard bearings provide ample support for the agitator shaft, remain free from abrasive action by the material being mixed and also eliminate bearing loads on the stuffing boxes. Heavy-duty design includes a rigid frame that is free from vibration, plain or stainless steel tank and a geared head motor with roller chain drive. Discharge at center or either end is optional. Available with Spiral Ribbon Agitator for paste, semi-paste, granular or liquid products.



DRY COLOR AGITATOR

Optional, supplied when necessary for materials such as heavy-bodied powders.

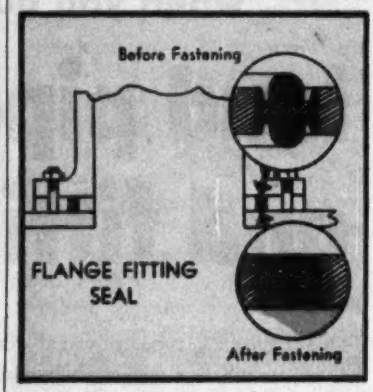
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DAY

THE J. H. DAY COMPANY, CINCINNATI 22, OHIO

prevent its undue distortion under pressure.

Valves are supplied in either aluminum or brass. Stainless steel or other desired materials are supplied on special order. Standard connections are ⅛- or ¼-in. male pipe fittings. Operating temperatures range from 40 to 280 deg. F. in standard units and from −80 to +400 deg. F. where specified. — *James-Pond-Clark, 2181 East Foothill Blvd., Pasadena 8, Calif.*



Sealing Device Is in the Groove

Contacting metal-to-metal surfaces can now be sealed by a new device called the Gask-O-Seal. Sealing action is provided by a rubber sealing gland which is mechanically bonded in a machined groove on the metal surface. Seals can be made in a wide variety of sizes and configurations.

Several advantages are claimed over flat gaskets or O-ring-in-groove sealing. There is no cold flow under either high or low pressures. A perfect seal is obtained with low bolt torque so that heavy reinforcement of flanges is not necessary. Rugged one-piece construction permits re-use; the rubber is fully retained and cannot blow out. There is always full metal-to-metal contact of the fastening surfaces, which assures maximum strength.— *Franklin C. Wolfe Co., Inc., 3644 Eastham Drive, Culver City, Calif.*

Magnetic Rapper Cleans Cottrell Plates

Rapping puffs or stack clouding associated with Cottrell precipitator operation have been eliminated by a new rapping system. Vibration of the collecting plates occurs at regular timed intervals of approximately one minute. Thus, there is a more or less

continuous dust fall into the collecting hoppers. This eliminates heavy dust fall at widely separated intervals with its corresponding re-entrainment of dust.

The rapper unit is essentially an electromagnet consisting of a solenoid coil, steel plunger, and return spring. These parts are enclosed in a hermetically sealed steel case. The plunger which serves as the armature of the electromagnet slides within a graphite impregnated tube.

The rapper case is welded to the end of a horizontal rapper bar. Protruding through the precipitator wall, via a stuffing box, the rapper bar is welded to the edges of a number of parallel plates comprising a bank of collecting electrodes.

Power to operate a number of these rapping units mounted on a precipitator comes from one central point. This is designed to deliver current to each unit in turn on a time cycle. Rapping frequency and intensity are adjustable to meet specific requirements.—*Research Corp., 405 Lexington Ave., New York 17, N. Y.*

Popular Vacuum Pump Undergoes Modification

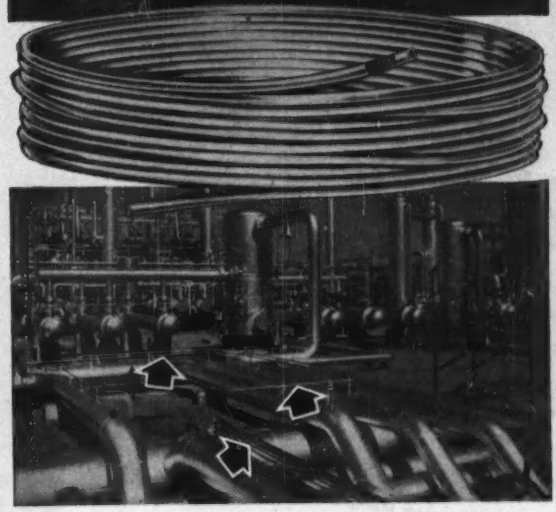
Although basically the same in design and outward appearance, Model G vacuum pump incorporates several new features. Among these are a modern type of shaft seal which minimizes maintenance. Lubrication is completely automatic and freedom from leakage is guaranteed. An oil filter in the shaft seal line gives special protection to bearings at this point. A solenoid valve in the oil supply line automatically prevents flooding in the event of power failure.

A side entrance intake acts as a baffle against entering solids; additional protection is afforded by a screen filter. New valve-stops prevent the copper beryllium springs from reaching coil to coil compression at any time.—*F. J. Stokes Machine Co., 5500 Tabor Road, Philadelphia 20, Pa.*

Butterfly Valve Operates With Ease

A new butterfly valve recommended for use on liquid, sludge or dry material lines features speed and ease of operation. Any combination of interchangeable end connections may be used. The entire sealing section containing seat, disk and handle can be removed for inspection, cleaning or

Save 40% with ALCOA UTILITUBE



Instrument air lines of ALCOA Aluminum Coiled Tube, still in good condition after five years of outdoor service at Sun Oil Company's Delhi (La.) Gasoline Plant, have required no maintenance since they were installed early in 1948.

ALCOA UTILITUBE* is aluminum coiled tube made of a specially selected alloy to provide low cost, easy workability and high fatigue strength.

Alcoa Utilitube offers savings up to 40 per cent over copper . . . has excellent on-the-job forming and flaring properties. It is available in economical, long lengths up to 1,000 feet or more, depending on size. It stands up well under vibration . . . has high resistance to most industrial atmospheres and to many liquids and gases.

Use Alcoa Utilitube for:

- Air for pneumatic and hydraulic control circuits and brake lines.
- Gasoline and fuel oil for internal combustion engines.
- Lubricating oils for engines and machines.
- Fluids for hydraulic systems.

For complete details, write for the new booklet: "Alcoa Utilitube."

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For process chemicals—catalysts, catalyst supports and desiccants—investigate ALCOA *Chemicals.*

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The cost involved in equipping and installing new manufacturing processes underlines the value of laboratory investigation and pilot-plant operation.

Nichols services provide a well-equipped laboratory, staffed by experienced engineers and technicians, qualified to perform experimental and custom roasting and the design of equipment to meet specific needs. Our laboratory is equipped with or we can make available to our clients the following pilot-plant equipment:

36" Nichols Herreshoff Multiple Hearth Furnace—For capacities up to 250 lbs. per hour.

18" Herreshoffing Unit—For small-scale batch testing, up to 30 lbs.

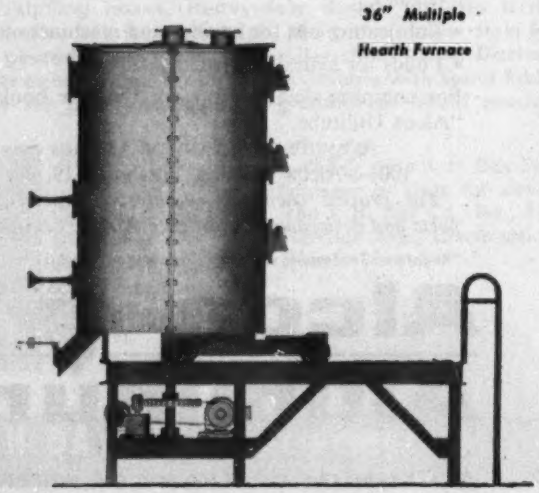
Portable Nerco-Niro Spray Dryer—Capable of atomizer speeds up to 50,000 R.P.M. and temperatures up to 575°F.

12" x 48" DWIGHT-LLOYD Sintering Machine—Capacity to 600 lbs. per hour.

Write for descriptive bulletin on Nichols Laboratory and Pilot-Plant Equipment and Services.

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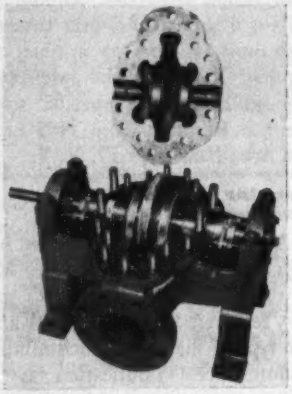


Nichols Herreshoff 36" Multiple Hearth Furnace

replacement without disconnecting the line.

Valve-disk seals against a resilient, oil and acid-resistant seat. Complete shut-off is attained against pressures up to 150 psi. or against vacuum. All valve sizes have a full hole opening providing unrestricted flow without turbulence. The handle mechanism is indexed to hold the valve in fully open or closed position.

Valves are manufactured in sizes from 2 through 12 in. Any combination of threaded, flanged or welding end connections can be furnished. Valve bodies and disks can be supplied of steel, bronze, aluminum or other alloys as required.—*Keystone Tool Corp., 5325 Kirby Drive, Houston, Texas.*



Double Suction Pump Fits Smaller Space

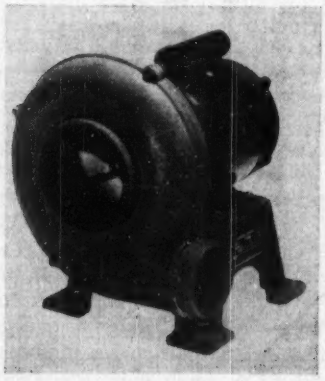
A new series of single-stage double suction centrifugal pumps has been designed for compactness, decreasing overall length as much as 50%. These Fig. 3405 pumps include renewable stuffing box bushings, sealed bearing houses, cowl type glands suitable for use with quenching liquids, stainless steel impeller keys, Teflon water-seal rings, die-formed stuffing box packing, and corrosion-resistant gland bolts.

Pump casings are horizontally split to permit removal of the upper casing without disturbing suction and discharge piping, or pump and driver alignment. Packed type stuffing boxes are standard, but mechanical seals of either single or double type can be furnished on order. Changes from conventional stuffing box to the mechanical seal and vice versa can be made easily in the field.

Mounting dimensions of all pumps within each group are identical, giving

wide ranges of interchangeability. Motor drive bedplates are standardized, being jig-drilled and tapped to accommodate all motor frames within the scope of the bed-plate.

Capacities range from 200 to 6,400 gpm. with heads up to 260 ft.—*Goulds Pumps, Inc., Dept. CE, Seneca Falls, N. Y.*



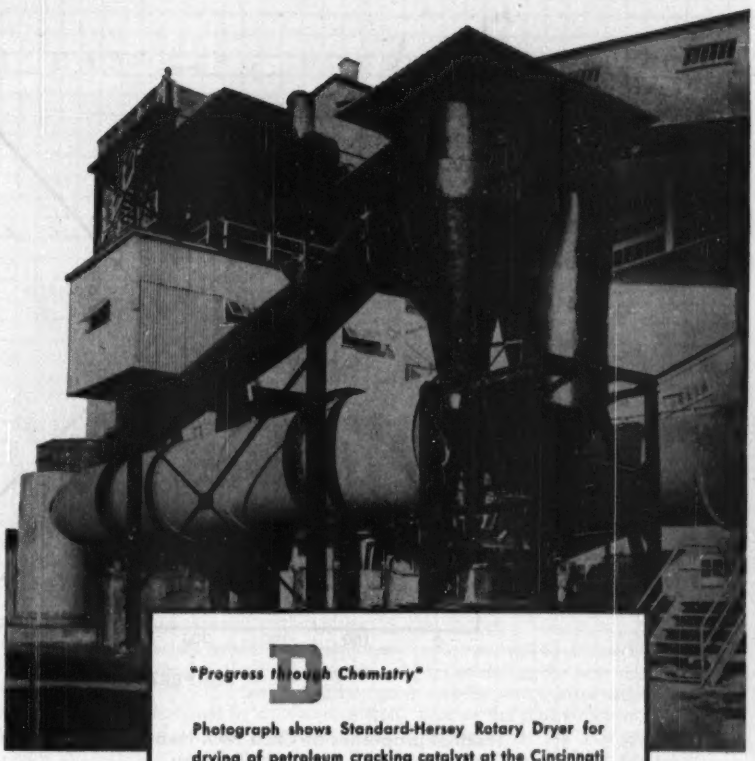
High-Pressure Blower Removes Fumes, Dust

A precision made all-aluminum blower is now available for the removal of fumes, smoke, dust, sawdust, and obnoxious odors. Capacity of the unit is up to 450 cfm. The standard model made with a 5½-in. inlet and a 3½-in. outlet is driven by a 1/6-hp. 115-v. single-phase a.c. 3,450-rpm. motor. Larger sizes for operations at different speeds are also obtainable.—*Standard Electric Mfg. Co., Inc., West Berlin 12, N. J.*

Plastic threaded pipe fittings molded of Boltaron 6200 polyvinyl chloride are now available in size ranges from ¼ to 2 in. Stock items include tees, 45- and 90-deg. elbows and couplings—*H. N. Hartwell & Son, Inc., P. O. Box 35, Boston, Mass.*

Quikupl stainless steel fittings are now being furnished with butyl rubber seals. Use of these seals increases the effectiveness of the fittings on sulphuric, hydrochloric, phosphoric, acetic, nitric and chromic acids, as well as alkalies and hypochlorites.—*Cooper Alloy Foundry Co., Hillside, N. J.*

Pipe fill cap constructed of brass is now being offered for use on pipelines fitted with Ever-Tite couplers. The fill cap is mounted on the coupler and locked in position by one lever handle.—*Ever-Tite Coupling Co., 254 W. 54th St., N. Y.*



"Progress through Chemistry"

Photograph shows Standard-Hersey Rotary Dryer for drying of petroleum cracking catalyst at the Cincinnati Plant of The Davison Chemical Corporation. Patented Standard-Hersey intermediate-feed system makes the unit in reality a combination flash and rotary dryer with most desirable characteristics of each.

THE DAVISON CHEMICAL CORPORATION

CHOOSES

STANDARD-HERSEY DRYING

Each year scores of new names are added to the list of well-known Standard-Hersey Dryer users. The Davison Chemical Corporation is another leader in its field which has joined the swing to STANDARD-HERSEY drying.

For both fabrication facilities and engineering know-how, you can count on STANDARD—always in the forefront of dryer developments for over half a century. It pays to STANDARD-IZE.

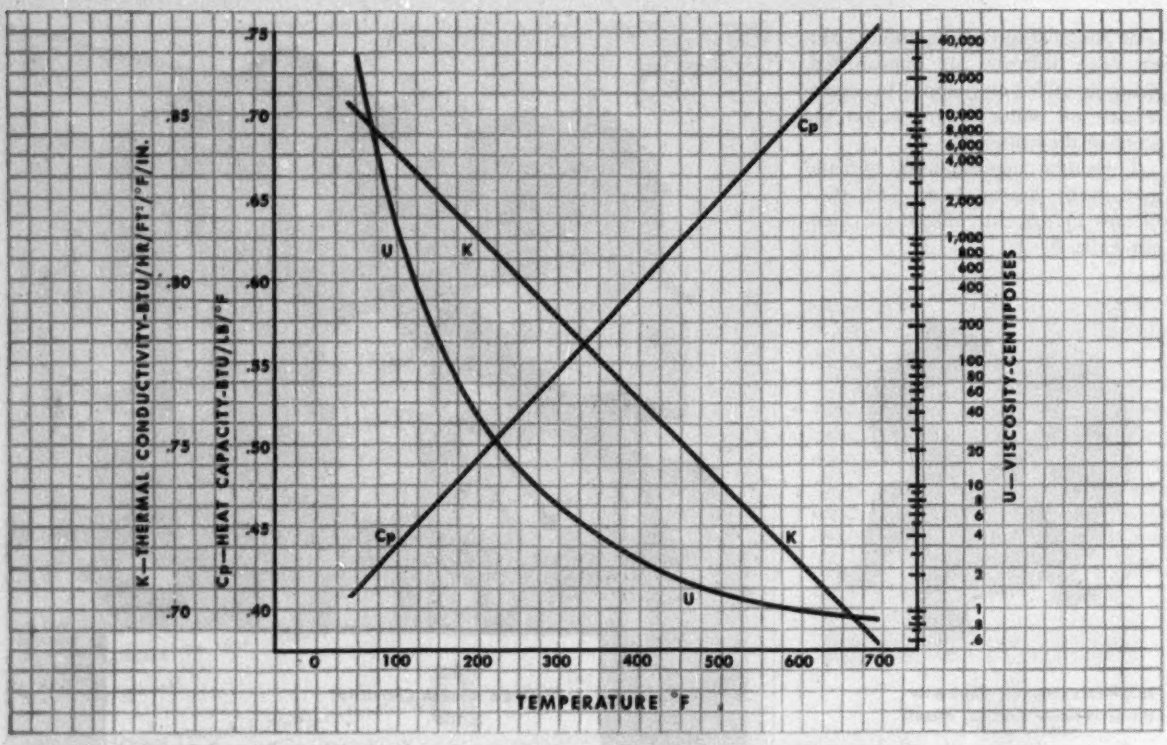
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Thermal properties of Circo XXX Heavy Heat Transfer Oil are indicated as follows: thermal conductivity (K); heat capacity (Cp); viscosity (U).

WHY IS CIRCO XXX HEAVY AN EXCELLENT HEAT TRANSFER MEDIUM

for temperatures as high as 600 F?

because:

1 Its high thermal conductivity assures fast, efficient heat transfer to the process material

2 Its high heat-carrying capacity assures maximum efficiency over its entire operating temperature range

3 It doesn't form hard carbon deposits, which reduce heat transfer efficiency

4 Its low vapor pressure and high initial boiling point prevent pressure buildup

5 Its viscosity is low enough to permit easy circulation with any pump used in an oil-type heat transfer system

Other important properties of Circo XXX Heavy Heat Transfer Oil

Viscosity, SUS at 210 F	145-155
Gravity, Specific	0.94-0.96
Acidity	neutral
Carbon residue	0.5 max
Demulsibility	good
Initial boiling point	approx 860 F
Vapor pressure at 600 F	nil

For more information about heat transfer oils and systems, send for "Circo Heat Transfer Oils." Write SUN OIL COMPANY, Philadelphia 3, Pa., Department CE-5.

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Crane Hook Swing Reduced to Minimum

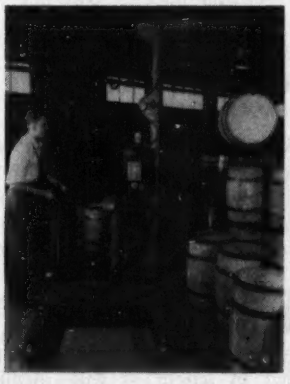
A new type of hoisting crane incorporates features to eliminate vertical creep and reduce hook swinging to a minimum. Originally developed for transporting radioactive materials, details of the crane have now been released for industrial application.

In normal crane operation, momentum keeps the crane hook swinging after the crane carriage has stopped. In the new unit a servo-mechanism replaces the normal carriage drive, moving the carriage in accordance with electrical signals.

The crane operator determines the direction he wishes the crane to travel and turns the control knob on the instrument panel. The crane automatically moves in the direction chosen and while doing so transmits electrical signals to the servo mechanism regarding its position, speed of movement and amount of swing in the load.

When the crane has reached the desired position it automatically stops, then moves to compensate for the swinging load. This action allows the load to dissipate its oscillatory energy.

A continuously variable-speed hoisting drive assures smoother and more accurate vertical control of the load. A feedback arrangement incorporated in the drive smoothly and positively stops vertical movement and prevents creeping.—*Argonne National Laboratory, P. O. Box 299, Lemont, Ill.*



Portable Crane Speeds Materials Handling

An electrically-operated, revolving-base, portable crane speeds handling, saves man-hours, and provides increased safety. Large heavy objects are easily moved from inaccessible locations without need for clearing entry space. Anti-friction bearings permit easy lateral movement. Capacities range from 500 to 5,000 lb.—*Barrett-Cravens Co., 4609 Southwestern Blvd., Chicago, Ill.*



MATERIALS HANDLING CIRCUS GOES ON TOUR

Latest materials handling techniques and equipment will be demonstrated in many far-flung corners of the U. S., Canada and Mexico during the next two years. Yale and Towne Mfg. Co. has packed two giant over-the-road trailers with equipment to be demonstrated by a seven-man crew. One of the trailers, when empty, is fitted for use as a movie projection room. A 68 by 40 ft. Big Top gives the show an authentic circus atmosphere. The tour itinerary is available from the manufacturer.—Yale & Towne Manufacturing Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa.

Lift Stacker Fits Cramped Space

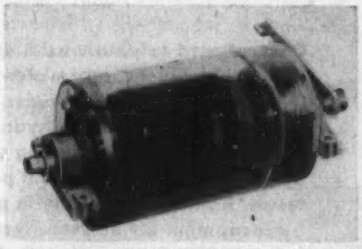
Designed for operation in minimum aisle space and over low capacity floors, a new telescopic tilting-fork stacker is claimed to give big truck performance. Built in capacities of 1,500, 2,500 and 3,000 lb., these units have lifting speeds from 21 to 14 fpm.

Two standard models are offered in each capacity. One has 83-in. over-all height with 64-in. free lift and 130-in. maximum lift. The other model, especially designed for highway truck loading, has a 68-in. over-all height with 49-in. free lift and a maximum lift of 100 in.—*Clark Equipment Co., Powrworker Dept., Buchanan, Mich.*

Hand Truck Trailer Serves Dual Purpose

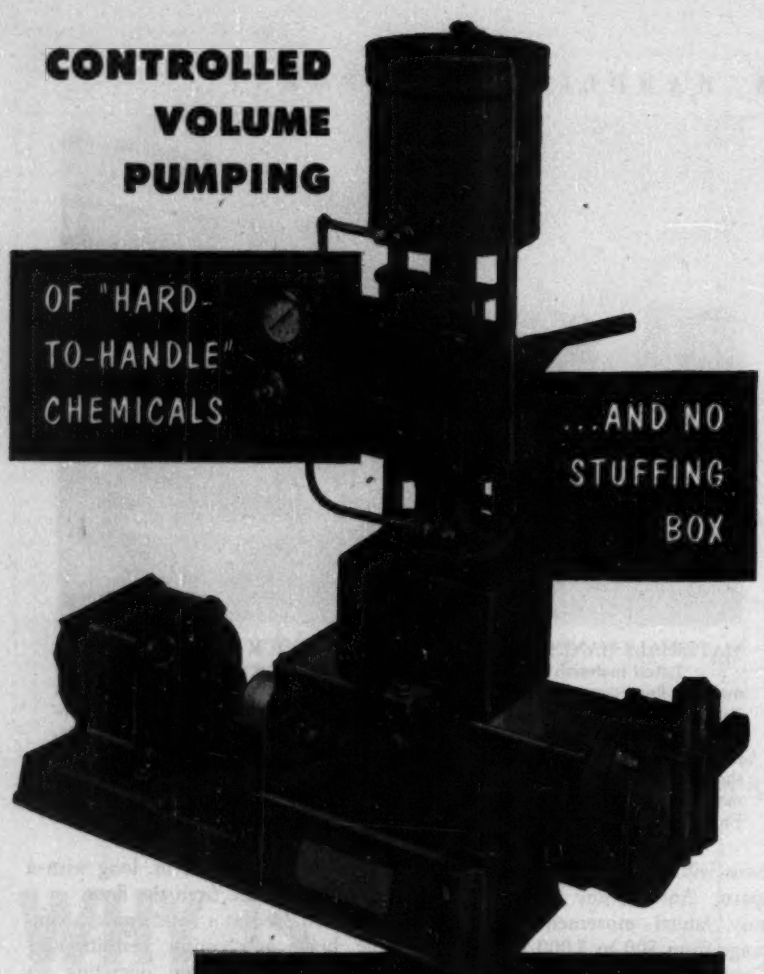
A new all-steel caster-steer trailer has use either as a hand truck or as a trailer for trackless train operations. Rated for 4,000-lb. capacity, the truck is 36 in. wide by 62 in. long with a flush deck 13 in. from the floor.

When used as a hand truck, a simple brake mechanism permits easy manual control when operating on grades. Brakes are applied by depressing a hand-operated lever conveniently located on the caster-end pipe rack. Safety self-couplers at each end of the unit fit it for trackless train operation. Wheels are roller bearing mounted with solid rubber tires.—*Mercury Mfg. Co., 4130 South Halsted St., Chicago 9, Ill.*



Belt Conveyor Pulley Contains Drive Motor

A new slant on driving belt-conveyor pulleys is to place electric motor, reduction gears and all moving parts inside the pulley. This eliminates all countershafts, speed reducers, sprockets and chains. Operational



Lapp

Auto-Pneumatic

PULSAFEEDER

Concentrated sulphuric acid, sodium sulphite, filter aid slurries, liquid caustic, any water-treating chemical . . . hold no fears for the Lapp Pulsafeeder. It's the positive-displacement metering pump with the hydraulically-balanced diaphragm —no stuffing box or running seal. Pumps against pressures up to 2,000 lbs., at constant pumping speed—variable flow results from variation only in piston stroke length, controlled by instrument air pressure responding to flow-orifice meter, flow-positive meter, pH control, flow variable-pH variable in combination, or other control instruments.

NEW BULLETIN AVAILABLE. Write for Bulletin 300, just issued. 24 pages of description, specifications, typical applications, flow charts. Lapp Insulator Co., Inc., Process Equipment Division, 738 Maple Street, Le Roy, N. Y.

safety is increased and all weather, grit and dirt are sealed out.

The motor, mounted inside the shell, is held stationary by a torque arm attached to the conveyor frame. Motion is transmitted to the shell through suitable reduction gears driving a ring gear attached to the shell. A simple oil-bath gear compartment provides a lubricating bath for the reduction gears and front motor bearing. Motor and head pulley are cooled and ventilated by holes in the drum. Leads to the motor enter the head pulley through a hollow conduit passing through the drum end-bell and bearing. Pulley sizes vary from 5 to 30 hp. and are available in various widths.—*Iowa Mfg. Co., Cedar Rapids, Iowa.*

Container Holds Hot Atoms

A new high intensity shielding container is suitable for the shipping and storage of Cobalt-60 or other industrial radioactive sources. The new container will hold up to approximately 800 millicuries of activity.

An outer shell of ¾-in. malleable iron is filled with lead to provide an effective shielding equivalent to 4 in. of lead. When the container is opened a unique wedge-shaped cover pivots up and back, providing a 4-in. lead shield between the exposed source and the user.

Container measures approximately 10¾ in. high and weighs 150 lb.—*Tracerlab, Inc., 130 High St., Boston 10, Mass.*

Portable Conveyor Has Adjustable Length

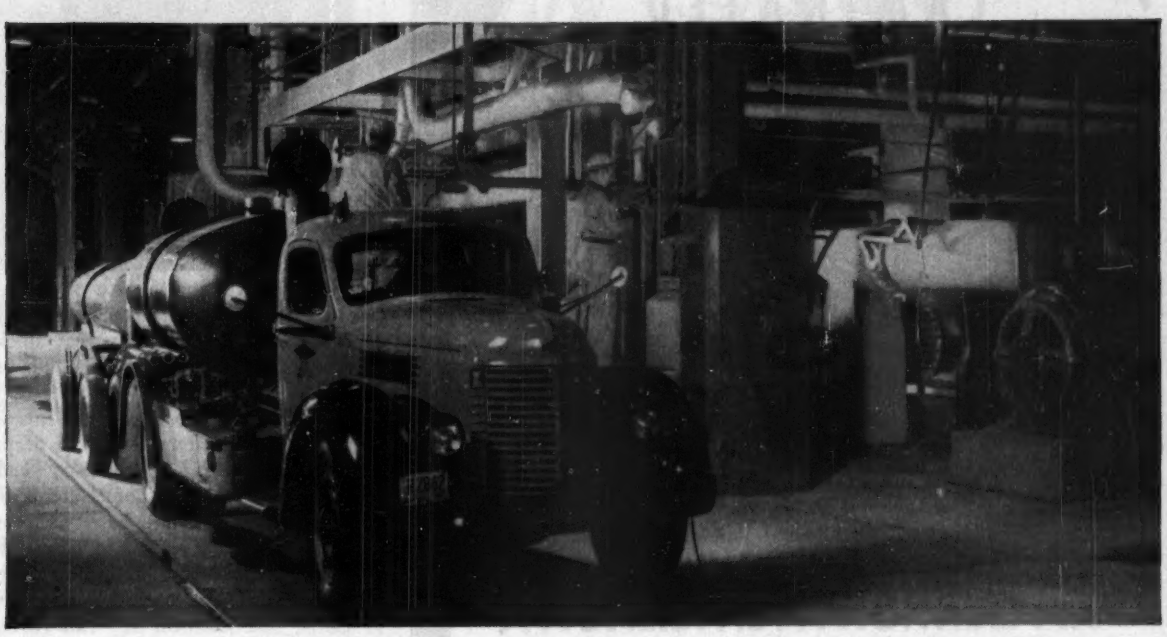
A new double-boom portable conveyor can achieve an open length 220 percent greater than its closed length. Designed for heavy-duty applications, the unit is completely counterbalanced for ease of handling.

Designed to carry loads varying from 50 to 100 lb. per linear foot, the power-operated double boom can be varied in length at will. Available models have a boom length variation of 8 to 16 ft. up to 16 to 61 ft.

Leg design can be for fixed height or adjustable to permit elevations up to 30 deg. Belt speeds are variable either forward or reverse.—*Stewart-Glapat Corp., Zanesville, Ohio.*

BOILER CLEANED CLEANER BY DOWELL SERVICE

Chemical solvents removed 1650 lb. of deposits from boiler previously "cleaned" by turbining



When you consider that liquid chemical solvents will reach wherever water will flow, you can soon appreciate the many advantages of cleaning with chemistry.

Where mechanical devices, rattling, and turbining fail to clean—in crevices, around angles, through openings—Dowell solvents are designed to dissolve and loosen scale and sludge . . . carry away these profit-stealing deposits quickly and easily.

For example, Dowell recently cleaned a 150,000 pphr boiler that had previously been turbine-cleaned. Although the chemical cleaning required only a few hours, Dowell engineers removed 1,650 *additional* pounds of deposits from the boiler. Best of all, no scaffolding or dismantling of equipment was necessary. Dowell-designed equipment was used to introduce special liquid solvents through regular connections. Downtime was kept to a minimum.

What is *your* cleaning problem? Dowell has extensive experience in cleaning all kinds of process and heat exchange equipment. Dowell furnishes trained personnel, pump trucks, and control equipment.

Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing.

For further details or estimates, call your nearest Dowell office or station. Or write to Tulsa, Dept. E-33.

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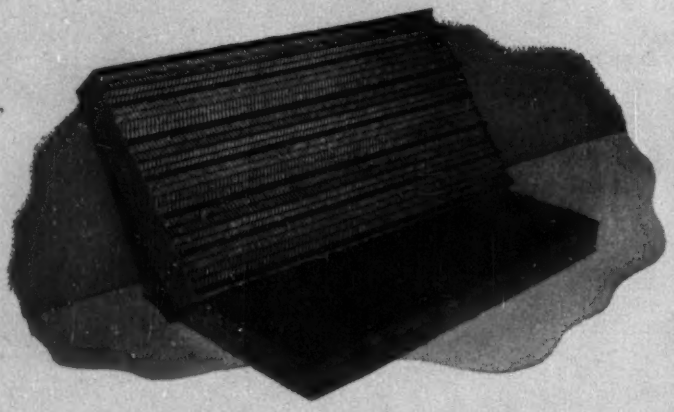
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Long-fibre BLANKETS

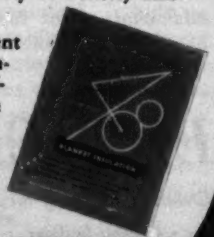


Vastly Improve Insulation
APPLICATION . . . EFFICIENCY . . .
PERFORMANCE!

Here's Why: Copr-fibre Blankets are made by laminating long, mineral wool fibres together to form a tough, resilient blanket *before wire mesh is attached.*

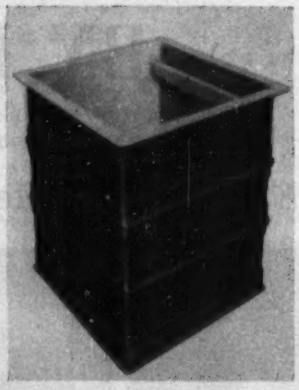
As a result this exclusive Copr-fibre two-stage manufacture gives you these advantages:

- **FASTER APPLICATION,** because laminated blankets cannot loosen or fall apart under the abuse of handling. And because Copr-fibre blankets come in convenient large sizes, are light in weight, clean, shot-free.
- **MORE INSULATING EFFICIENCY,** because laminated, longer fibres guarantee lower thermal conductivity. Two-stage manufacture is your insurance of uniformity of density and of consistency in all dimensions.
- **BETTER PERFORMANCE,** because resilient long-fibre Copr-fibre blankets maintain integrity, both of insulation and weatherproofing, throughout expansion and contraction cycles of heated and cooled equipment.



SEND FOR THIS BULLETIN. Copr-fibre Bulletin 511 gives you all the facts on what we believe is the only modern blanket insulation. Your copy will be sent free upon request. Write today.

Telephone: Aurora 9207



Fabrication Technique Lowers Plastic Tank Cost

Corrosion resistant fiber-glass-plastic tanks in special sizes are now being fabricated without the use of expensive special molds. Tanks are built from Laminex fiber glass flat stock which keeps cost below aluminum or stainless steel tanks.

Tanks can be built up to a maximum of 12 ft. on a side by 4 ft. deep. Construction is straight-sided and square cornered. All joints are pressure bonded. Walls have uniform thickness and are reinforced with horizontal ribs where necessary to give high impact resistance.—*Laminex Corp., 994 Jefferson St., Fall River, Mass.*



Deepwell Pump Housing Protected by Porcelain

Indicative of the new uses of porcelain enamel for heavy-duty industrial applications is the interior coating on this deepwell pump housing. The housing is part of a pump used to draw water from extreme depths. The hard, smooth, porcelain-enamel coating covers all surfaces wetted by the water. Each housing of the multi-

stage pump is similarly protected.

The glass-like surface of the porcelain is said to reduce friction between the flowing water and the pump casing.—*Barrows Porcelain Enamel Co., 137 Pleasant Ridge Station, Cincinnati, Ohio.*



Structural Plastic Now Used for Ducts

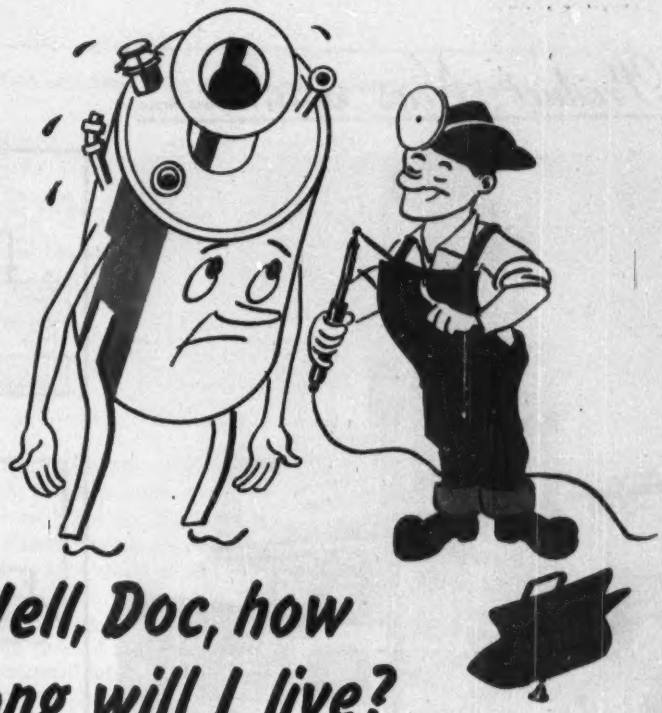
Tanks and ducts are now being fabricated to specifications with Iolyte, a Fiberglas reinforced polyester laminate. Fabrication is done without use of molds, and there is no limitation as to size and shape.

Iolyte has the tensile strength of steel, yet weighs only one-fifth as much. Resistance to heat is greater than for plastic coatings, and there is no problem of chipping, crazing, cracking, scratching or other physical damage. Duct work is easily installed and is especially recommended for corrosive fumes.—*Schori Process Div., Ferro-Co., Corp., 8-11 43rd Rd., Long Island City 1, N. Y.*

Plastic Tank Liners Are Leakproof

Agilene (polyethylene) and Agilide (unplasticized polyvinyl chloride) are now being custom fabricated into leakproof tank liners. These liners can be furnished complete with drain and overflows, including pipe flanges, fittings and valves of the same material.

The welding method employed during fabrication is said to guarantee a leakproof liner that will reduce maintenance and replacement costs of tanks containing corrosive liquids. The tank liners are fabricated in all sizes and shapes with wall thicknesses up to 1 in. Where size and design complexity dictate, the fabrication can be carried out at the installation site.—*American Agile Corp., P. O. Box 168, Bedford, Ohio.* —*End*



Well, Doc, how long will I live?

The service life of your stainless steel processing equipment is determined by your fabricator. In the professional skill of his mechanics, welders and craftsmen lies the answer to the useful life of that equipment.

For stainless fabrication requires a specialist — with manpower trained, experienced and equipped for that work. A general practitioner might miss up on something that would impair the strength or corrosion resistance of stainless steel. The special technique required for sound welds — the right degree of heat in welding a seam, the proper finish for your application — round corner construction to allow removal of corrosive materials — these often determine how long your equipment will "live" in service.

Years of working with stainless steel have shown us that many hidden weaknesses in the finished vessel can be avoided by proper methods of fabrication. For your next stainless steel vessel, consult with us.

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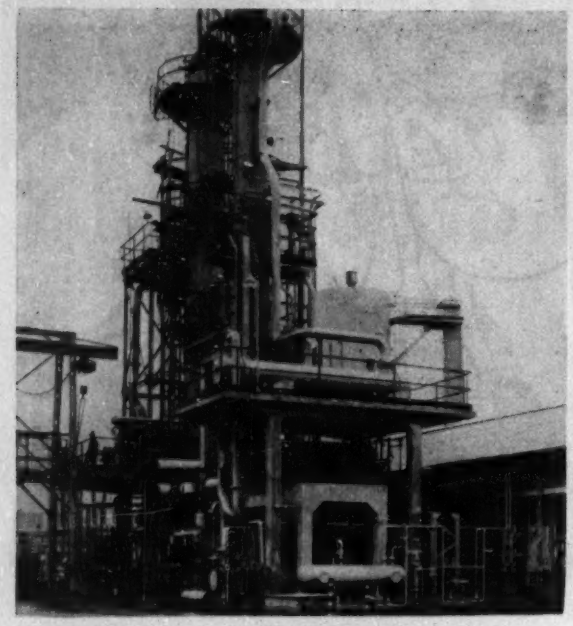
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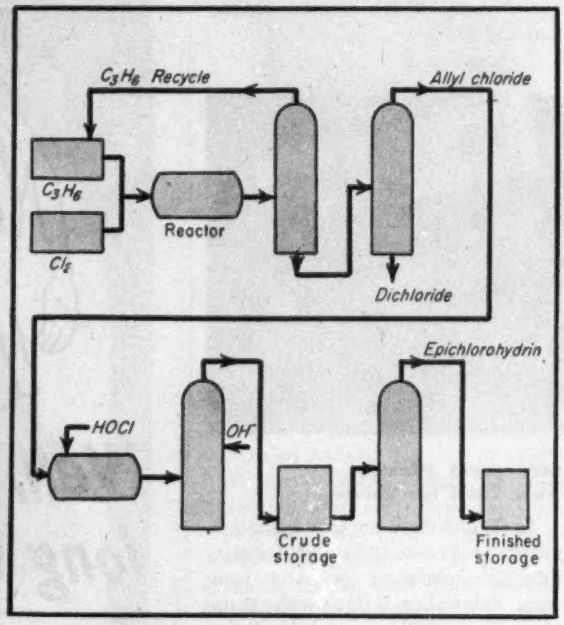
CORROSION RESISTANT PROCESSING EQUIPMENT



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NEW UNIT in Houston will triple epichlorohydrin supply.



KEY TO PROCESS is low-cost allyl chloride from propylene.

Riding the Epoxy Comet

Output of the nation's only commercial producer of epichlorohydrin has just been tripled to keep up with demands made by epoxy resin market.

For every pound of epoxy resins made, 0.4 of a pound of epichlorohydrin is used. And since the market for epoxies is currently bursting its seams, production of epichlorohydrin has recently been tripled.

The new facilities were recently put on stream in Houston by Shell Chemical Corp., the only commercial producer. Shell first made epichlorohydrin in 1946, evidently regarding it as something of a risk at the time, for the market was not well defined. A pretty good picture of its subsequent growth can be drawn from a look at the growth of its biggest market. In 1946 the demand for epoxide resins was under one-half million pounds; in 1952 it climbed to 6.7 million pounds. By the end of this year industry-wide capacity will be 25-30 million pounds, according to some estimates. Such increases have absorbed the full capacity of the original epichlorohydrin plant and may justify the current three-fold expansion, even though Shell seems to feel that, as in 1946, their productive capacity will be ample for this growing market for some time to come.

It is, in general, epichlorohydrin's chlorine atom and epoxide ring that make it an extremely reactive and versatile compound. It is a colorless, mobile, toxic liquid with a characteristic odor.

To make the epoxy resins, epichlorohydrin teams up with acetone and phenol. The resulting resins, thermal setting in character, are going great guns because of superior properties for surface coating, metal-to-metal bonding without welding, stabilizing PVC, potting, casting, and laminating.

Although epoxy resins account for the largest volume use of epichlorohydrin, it enjoys widespread use as a stabilizer for polyvinyl chloride and corrosion inhibitor in chlorinated insecticides. But only small amounts—0.3 to 0.5 percent based on the weight of chlorinated compound—are necessary to be effective.

It is being used as a raw material for the manufacture of a multitude of glycerol and glycidol derivatives used as plasticizers, solvents, dyestuff intermediates, surface active agents and pharmaceuticals and as intermediates for further synthesis. It is used directly as a stabilizer for chlorinated rubber and other chlorine-containing polymers.

A large number of condensates prepared from epichlorohydrin and various poly-functional substances are disclosed in the patent literature. These condensates are claimed useful, directly or indirectly, in such applications as the following: surface coating compositions; adhesives, cements, and shellac substitutes; tanning, demulsifying and surface active agents; pharmaceuticals; dyestuffs for textiles and color photography; capillary-active agents for the textile industry; and as plasticizers, softening agents and dressing agents.

Epichlorohydrin is a good solvent for cellulose acetate, rosin and ester

gums, and despite its toxicity, may find some use for such a purpose.

Shell's initial foray into epichlorohydrin production was an outgrowth of its research on allyl chloride. When company engineers learned to make low cost allyl chloride from propylene they had the key to commercial production of epichlorohydrin as well as their much-publicized synthetic glycerine.

Cracked gases containing propylene are piped to the Houston plant from the neighboring refinery of Shell Oil Co. Liquid chlorine comes from Diamond Alkali's electrolytic plant.

Getting chlorine into propylene by direct substitution without disturbing the double bond—once thought to be impossible—is achieved by carefully controlling reaction conditions. During the reaction, temperature nears an unprecedented high of 600 deg. C.; pressure of the propylene is raised from 40 to 260 psi. by 1,000-hp. compressor.

The purified allyl chloride treated with hypochlorous acid gives glycerol dichlorohydrin to which lime or sodium hydroxide is added to get epichlorohydrin.—*Shell Chemical Corp., 500 Fifth Ave., New York 36, N. Y.*

IN BRIEF—A capsulated listing of this month's newsworthy products

It's New . . .	It's Good for . . .	See Page . . .
Epichlorohydrin	Epoxy resins, insecticides	262
Methyl Phenyl Ether	Industrial solvents, heat transfer media	263
Silicone-treated Nickel	Shielding instruments from water	263
Antioxidant	Protecting engines from fuel sludge	263
Oxidizing Catalyst	Cutting air pollution and fuel costs	264
Fluorocarbon Plastics	Resisting high temperatures and strong chemicals	264
Motor Cleaner	Freeing motors frozen with alkalis	264
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Adhesive	Sequestrant, emulsion stabilizer, antioxidant	270
Acetophenetidin	Pharmaceuticals because of new physical form	272
Antibiotics	Control of mold in industrial plants	272
Fertilizer	Minimizing leaf or grass burn	272
Alloy	Resisting abrasion and extreme heat	272
Surface Coating	Adhering to various metal surfaces	272

Methyl Phenyl Ether

Has already proven itself as an industrial solvent and heat transfer medium.

The excellent heat stability and wide liquid range (—37 to 154 deg. C) of methyl phenyl ether has already made a place for it as a heat transfer medium although it has only just now become available in commercial quantities.

The compound, also known as anisole or methoxybenzene, shows a high degree of miscibility with a wide range of organic liquids and common solvent types.

Exceptions are water, glycol and glycerine. Its solvent capacity for vinyl polymers and copolymers suggest broader solvent use.

As a solvent, it acts as a weak base promoting syntheses where acids are formed in the reaction. Such reactions are common in the dyestuffs, pharmaceutical and other industries.

Anisole is valuable as a means of introducing the methoxybenzene group into organic compounds. The methoxy group significantly lowers the toxicity of compounds so anisole should be an important intermediate in the pharmaceutical industry for drugs such as antihistamines and analgesics.

Its high boiling point and wide liquid range make it particularly valuable for recrystallization. A large increase in crystal yield can be obtained by raising the temperature without exceeding the boiling point.

Its low vapor pressure minimizes vapor losses and permits its use as a modifier in lacquers to counteract the blushing caused by too rapid evaporation of low-boiling solvents. Another advantage is the high flash point (125 deg. F). This reduces fire hazard and often eliminates the need for explosion-proof motors.—*E. I. du Pont de Nemours, Inc., Wilmington 95, Del.*

Silicone-treated Nickel

Porous sheets shield delicate instruments from water.

A porous nickel sheet material treated with silicone provides a venting medium for instruments and at the same time keeps out water under conditions of rapid changes of altitude. The sheeting will not pass water at less than 3 psi. differential but it will pass air freely.

In addition to its obvious use in aircraft, the material will also protect instruments from rain or from accidental immersion in water.

The sheets can be cut to size and form required, subjected to mild forming operations and can be welded to solid threaded components or to other fittings for fastening to the equipment.—*Micro Metallic Corp., 30 Sea Cliff Ave., Glen Cove, N. Y.*

Antioxidant for Gasoline

To provide engines with greater protection from fuel sludge and gumming at lower cost.

C. H. Winans, development manager of Koppers' chemical division, explains that the company's new Impruvol 33 raises engine efficiency by retarding formation of vapor phase gum during the compression stroke. He goes on to say that it reduces varnish and lacquer coatings on cylinder walls, pistons and rings and hinders the development of acids which lead to corrosion and sludge.

The compound is a 33⅓ percent by weight solution of DBPC (di-tertiary-butyl-para-cresol) in toluene. DBPC is Koppers crystalline, trialkylated phenol, both non-staining and non-corrosive, which is used as a highly effective antioxidant for turbine lubricating oil and transformer insulating oil, for waxes and vegetable oils, and for rubber.

In addition to its economy, Impruval 33 is recommended to refiners because it can be added early in the refining process without loss in subsequent operations. In addition, its antioxidant power is not so greatly reduced by contact with metals in gasoline storage and fuel injection systems as is the case with many commercial antioxidants.

A phenolic type antioxidant, it does not impart the pink color to gasoline as do some amine type inhibitors. Thermal and chemical stability of Impruvol 33 makes it essentially free from any tendency to form induction system deposits. Tests are said to indicate that Impruvol 33 provides excellent stabilization of aviation gasolines and of tetraethyl lead fluids.—*Koppers Co., Pittsburgh 19, Pa.*



OXIDIZING CATALYST BED CUTS FUEL COST AND POLLUTION

A bed of Oxycats, block-shaped porcelain rods coated with a 0.003-in. film of catalytic alumina and platinum alloy, has literally made a plant run on its own smells. Installed here in an exhaust stack above Enamelstrip Corp.'s main coating line, the Oxycats oxidize noxious solvent fumes rising from a paint baking oven. In the process, the catalyst generates large quantities of heat which serves to cut plant fuel bills by 90 percent. Oxy-Catalyst, Inc., Wayne, Pa.

Fluorocarbon Plastics

Both Bakelite and Kellogg are increasing production to make more available for civilian use.

On the same day a few weeks ago, came announcement of expanded production facilities from two of the three makers of fluoro-carbon plastics. Bakelite Co. is building a plant in South Charleston, W. Va., for its fluorothene, known technically as polychlorotrifluoroethylene. It will produce about 50,000 tons a mo. when it goes on stream at midyear.

M. W. Kellogg Co. started up a plant in February for its Kel-F, also described as a high polymer of trifluorochloroethylene. Located in Jersey City, N. J., the new facilities will produce well over a million lb. annually.

Both Kel-F and fluorethene are remarkable for excellent high-temperature and chemical-resistant properties. Both resist heat up to about 400 deg. F. and withstand oxidizing agents like fuming nitric acid as well as strong caustics and acids. They are readily moldable.

These properties are of obvious value in such chemical industry applications as valve seats, diaphragms, gaskets and tank lines. However, until now military uses have absorbed much of the supply. The aim of the additional production facilities is to make more available for civilian use.

Production of Du Pont's Teflon (polytetrafluoroethylene), which now pretty well rounds out the fluorocarbon resin picture, will not be expanded. The company will make its Parkersburg, W. Va., facilities do for the present.

Du Pont, incidentally, supplies both Bakelite and Kellogg with raw materials for their fluorocarbon plastics. Kellogg uses fluorinated hydrocarbon gas (a refrigerant known as Freon 113) made at Du Pont's Chambers Works. From the same source, comes the monomer from which Bakelite makes its fluorethene.—*M. W. Kellogg, 225 Broadway, New York, N. Y.; Bakelite Co., 260 Madison Ave., New York, N. Y.*

Motor Cleaner

It will even free and clean motors frozen with alkalis.

Test-marketed in Milwaukee and other Wisconsin cities in December, a cleaner for motors and other electrical equipment is now going national. There are two forms. One, called EMC, is a dip type; one called DMC is for spraying.

They are both nontoxic, noninflammable, nonexplosive and without bad odor. They clean a motor while running and will even, it is said, free and clean motors frozen with alkalis.

In using the dip type, the motor is completely immersed, run for 3 to 5 min. (no longer than 7 min. or lubricants may be removed) then dried with compressed air. Frozen motors must be soaked 2 to 3 min., then run 3 to 5. EMC doesn't affect wiring, lacquer or insulation not affected by gasoline or oil.

Solvent can be used over and over if the cleaning tank has a lid to cut evaporation loss. However, if the solvent picks up too much oil and



CHEAPER SOIL CONDITIONER TO AIM AT LARGE-ACREAGE USE

Said to be nature's own soil conditioner in a highly concentrated form, a ferric ammonium complex called "flotal" is now in production at Stauffer's Richmond, Calif., plant. Its application cost is about 25 percent that of leading soil conditioners already on the market. Eventually, Stauffer hopes flotal will make soil conditioning of large acreage economically feasible for the first time. Stauffer Chemical Co., 420 Lexington Ave., New York, N. Y.



How Celite Mineral Fillers give a product low-cost bulk . . .



Making a little cleanser go a long way

SINCE HOUSEHOLD CLEANSERS are one of many products that require bulk in order to do their work efficiently and economically . . . it is not surprising to find Celite Mineral Fillers used as a standard ingredient in quality cleansers.

The reason is the great bulk per unit of weight of Celite Mineral Fillers . . . as well as their exceptionally low cost per unit of volume. In addition, they have a high absorptive capacity for perfumes and chemicals. Celite's porous, thin-walled cellular structure, from which these advantages are derived, adapts these diatomaceous silica powders to numerous industrial uses.

THESE CELITE PROPERTIES BENEFIT MANY TYPES OF PRODUCTS

Celite Mineral Fillers are composed of minute, multi-shaped particles that interlace to stiffen and strengthen admixtures. The microscopically small facets of these particles diffuse light so effectively that they can be utilized to impart any desired degree of flatness to a surface film. Their light, porous nature improves suspension, helps prevent segregation. Their high absorption properties and unique diatom structure make them unusually effective for overcoming caking in deliquescent materials.

If you are looking for the "extra something" to lift your product above competition—at no extra cost—why not discuss your problem with a Johns-Manville Celite Engineer? For further information and samples, write Johns-Manville, Box 60, New York 16, New York. In Canada: 199 Bay Street, Toronto, Ontario.

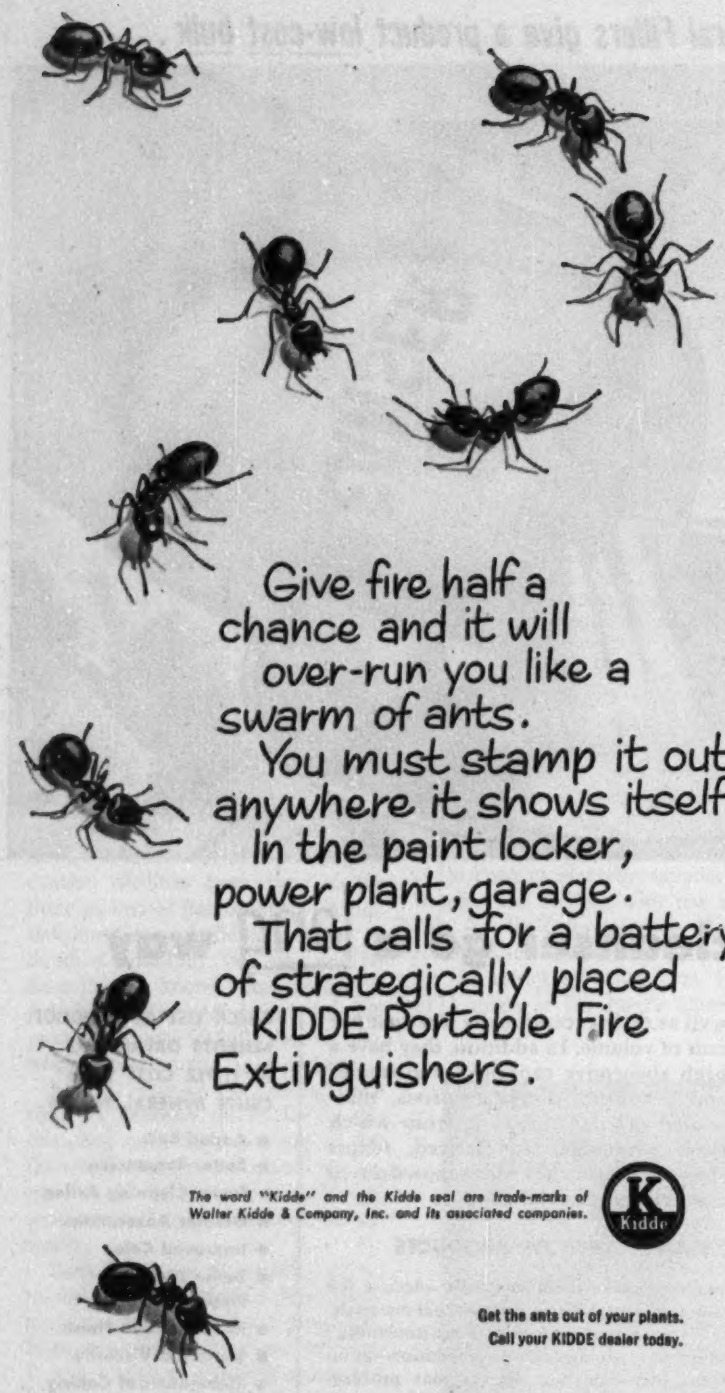
CHECK LIST OF PRODUCT BENEFITS OBTAINABLE AT LITTLE COST WITH CELITE MINERAL FILLERS

- Added Bulk
- Better Suspension
- Faster Cleaning Action
- Greater Absorption
- Improved Color
- Better Dielectric Properties
- More Durable Finish
- Increased Viscosity
- Elimination of Caking
- Higher Melting Point
- Better Dry Mixing
- Improved Dispersion

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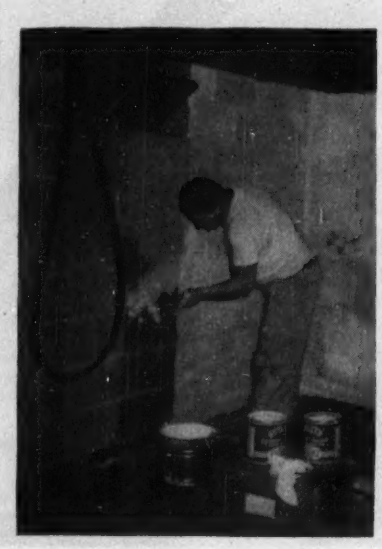
Johns-Manville CELITE®

MINERAL FILLERS



grease, it must be replaced to avoid an inflammable mixture.

The spray-type, DMC, is atomized on to clean various electric equipment or to remove paint spray dust and carbon. According to the manufacturer, it can even extinguish electric fire without generating phosgene.—*Northwoods Mfg. Chemists Inc., Porterfield, Wis.*



Silicone Cement Paint

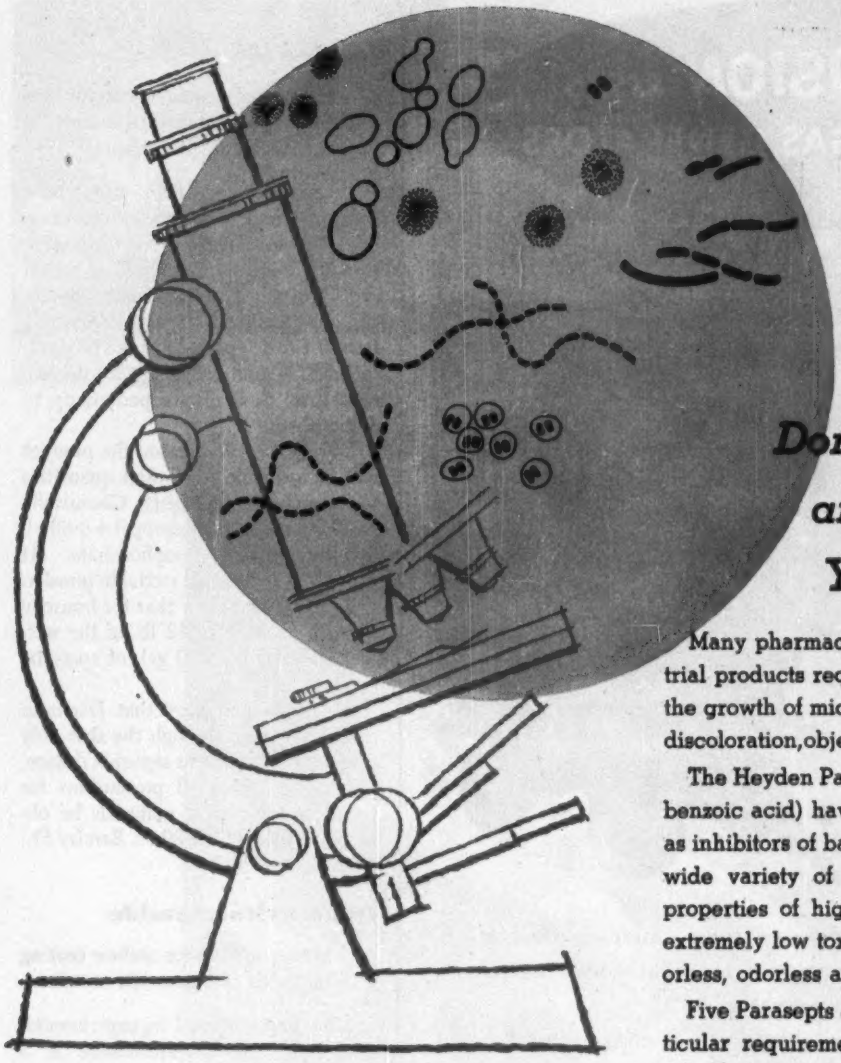
Fills microscopic pores in masonry to seal out seepage and dampness.

A new cement-based powder containing silicones plus metallic compounds is said to keep masonry dry even against an 8 ft. head of water, 500 psi.

The metallic compounds and silicones contained in the material, called Silitex SF, form an insoluble, nonreversible compound that quantitatively fills the pores and expands in the pores. This compound has unusual water repellency characteristics.

The silicones in Silitex SF produce a water repellent coating with a minimum of absorption, without eliminating the transpiration (or breathing) of the structure. In addition they provide exceptional durability.

The compound binds chemically and mechanically to the surface to which it is applied for maximum durability. Used by mixing with water, it must be applied within two hours of mixing. It retails at $3.95 a gallon.—*Prima Products, Inc., 10 East 40th St., New York 16, N. Y.*



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Many pharmaceuticals, cosmetics and industrial products require a preservative to prevent the growth of microorganisms which may cause discoloration, objectionable odor or deterioration.

The Heyden Parasepts (esters of parahydroxybenzoic acid) have long given valuable service as inhibitors of bacterial and fungal growth in a wide variety of products. They combine the properties of high effectiveness, stability, and extremely low toxicity, in addition to being colorless, odorless and practically tasteless.

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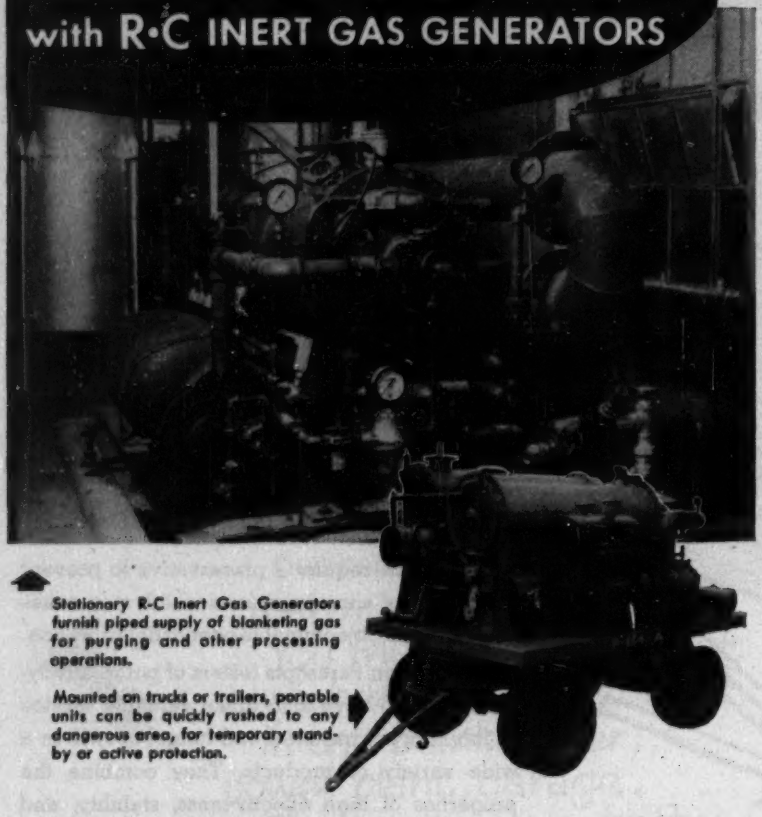
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Insecticide

Promising residual agent for controlling houseflies resistant to chlorinated hydrocarbons.

Laboratory and field tests have shown that a new phosphate compound is an effective residual insecticide for controlling houseflies which show resistance to chlorinated hydrocarbon insecticides. Sprays containing from 0.1 to 1.0 percent of the product, called Diazinon, have given effective fly control in barns for periods up to 3 months.

During the 1953 season the product will be available in limited quantities to research entomologists. Chemically it is 0,0-diethyl-0-[2-isopropyl-4-methyl-pyrimidyl (6)] thiophosphate. It comes as a 25 percent wettable powder.

Tests to date show that for housefly control, from 16 to 32 lb. of the wettable powder per 100 gal. of spray be applied.

Although it appears that Diazinon can be absorbed through the skin only after relatively large or repeated dosage, it is advised that all precautions for handling toxic spray materials be observed.—*Geigy Co., 89-91 Barclay St., New York 8, N. Y.*

Dimethylformamide

Strong solvent for surface coating materials and gases like acetylene.

Now being offered in experimental quantities, dimethylformamide is a strong solvent for surface coatings like nitrocellulose, cellulose acetate, cellulose triacetate and vinylite resins. In formulations requiring unique properties such as high solids content within fixed viscosity limits, dimethylformamide should be of value despite some disadvantages of hygroscopicity and a slow rate of evaporation.

It also has selective solvent properties. Aliphatic hydrocarbons, normally very slightly soluble in dimethylformamide at room temperature, are miscible at elevated temperatures. In addition, the low volatility of dimethylformamide and stability to heat facilitates the easy recovery of the solvent with a very low loss after repeated extraction cycles.

Dimethylformamide is one of the most efficient solvents for acetylene. It will dissolve 33-37 volumes of acetylene per volume of dimethylfor-



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mamide at normal temperature and pressure. At increased pressure, 150 atmospheres and room temperature, dimethylformamide will dissolve 375 volumes of acetylene.—*Commercial Solvents Corp., 260 Madison Ave., New York 16, N. Y.*

Protective Coating

Resin-based, they offer chemical resistance indoors and outdoors.

New Lankote 300 coatings are said to be proof against chemical, acid or alkali fumes. They are recommended to protect installations of gasoline, solvent, oil and chemical storage.

Thermoplastic, light-fast, resin-based coatings, they are formulated in white, aluminum and clear. They can be brushed or sprayed on masonry, metal, concrete or wood and they dry by solvent evaporation.

The coatings will not support fungus or mold and are resistant to weather, water and abrasion.—*Lankote Division, J. Landau Co., 221 Wooster St., New York 12,.N. Y.*

Adhesive

Suggested as a sequestrant, emulsion stabilizer and antioxidant.

A new organic salt called TEAC-90 permanently sequesters polyvalent metallic and alkaline-earth ions. It is said to be particularly effective with ferric ions forming colorless solutions on addition of ammonium hydroxide.

It saponifies acids such as oleic. Also it is said to disperse and solubilize hydrous oxides, rust, clays, organics, soaps and gums thus making it a valuable adjunct for the stabilization of emulsions, colloids and clay systems.

Derived from selected acids and amines, the compound is an amber, viscous liquid miscible with water and alcohols. With a boiling range over 100 deg. C, it is stable to moderate heat, dilute acids, alkali, oxidizing and reducing agents.

TEAC-90 has possibilities as an aid with initiators and activators in the polymerization of synthetic rubber and resins. It also possesses penetrating and spreading power. It serves as a plasticizer and latex stabilizer.

The oxidation of fats, soaps and chemicals as well as corrosion of steel are said to be minimized by small amounts of TEAC-90. And it retards

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In applications where high purity process materials are indispensable, B&A Purified Calcium Acetate has long been preferred by manufacturers for its consistently high purity and uniformity, its clean white color, and its free-flowing qualities. With an assay that exceeds 99% $Ca(C_2H_3O_2)_2.H_2O$, this B&A purity product offers many advantages over ordinary gray acetate of lime.

Tonnage quantities are readily available to fit your particular process requirements. For samples, further information, or immediate shipments, write or phone the nearest B&A office listed below.



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As a catalyst in preparation of metal resinates and in synthesis of metallic soaps



In manufacture of pharmaceuticals, synthetic resins, etc.

Other B&A High Purity Acetates Include:

ammonium acetate - purified

Assays in excess of 96% $NH_4C_2H_3O_2$, and is particularly low in iron and heavy metals. An ideal selection for such exacting process uses as manufacture of airfoam rubber; in medicine and pharmaceuticals; assistant in dyeing; and in the manufacture of heat transfer salts.

potassium acetate - purified and N.F.

Notable for its consistently high purity and uniformity, B&A Potassium Acetate assays 99% minimum $KC_2H_3O_2$. It is used in manufacturing pharmaceuticals and fine organic chemicals; as a humectant; as a catalyst in the manufacture of resins; and as an ingredient for anti-freeze mixtures.

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the putrefaction of various materials such as casein and glues which should make it an aid in water-based paints. —*Process Chemical Specialties, P. O. Box 345, Beverly, Mass.*

Acetophenetidin in the form of a coarse powder, more free flowing than the standard fine powder, is now on the market. Alone and in combination with many other therapeutic agents, acetophenetidin is commonly employed in analgesic and antipyretic formulations. The new physical form is believed to be better suited to certain pharmaceutical preparations.—*Monsanto Chemical Co., St. Louis 4, Mo.*

A new antibiotic use has been announced by Pfizer. The company has found that the compounds are efficient agents for the control of mold and bacteria in industrial plants. For this purpose they have made available in industrial grades such antibiotics as terramycin, penicillin, streptomycin, magnamycin—Chas. Pfizer & Co., 630 Flushing Ave., Bklyn. 6, N. Y.

Water-soluble fertilizer is now available which has been specially formulated to minimize leaf or grass burn. A 20-20-20 N-P-K composition called Folium, it contains a chemical which keeps the product in free-flowing condition and aids in the absorption of nutrients by the plant leaves–Monsanto Chemical Co., St. Louis 4, Mo.

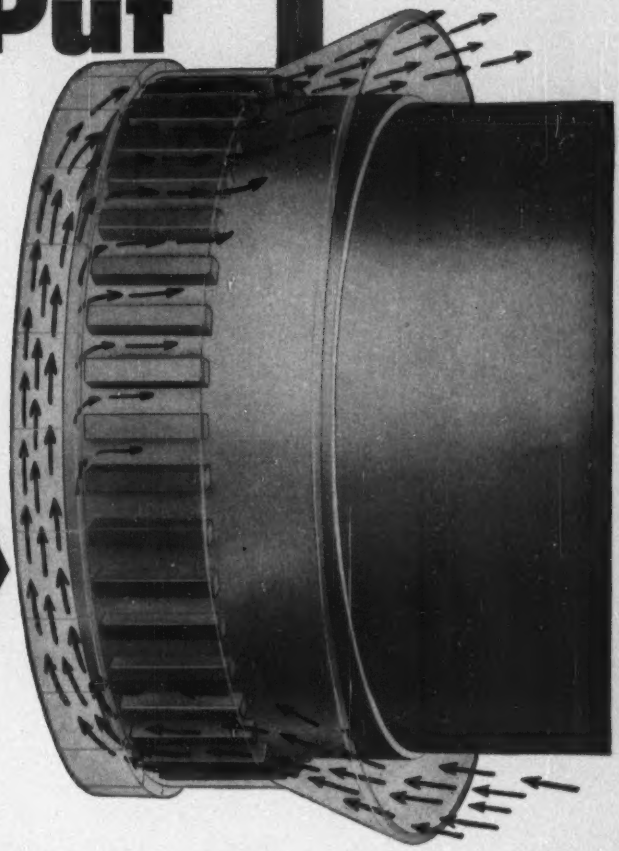
A hard-facing alloy called CM-119 is now being offered which (1) resists abrasion at the temperature of hot rolled steel, (2) withstands attack by molten copper and (3) can be applied by any good arc welding process.–Coast Metals, Inc., Little Ferry, N. J.

Resin surface coating has been developed which is said to have remarkable properties of adhesion to various metal surfaces including alloys of copper, steel, aluminum and magnesium. The cured film resists not only acid and alkali but also solvents and boiling aqueous solutions. It also makes the metal surface more receptive to adhesive bonding–Furane Plastics, Inc., 719 West Broadway, Glendale 4, Calif. —*End*

Nose Brick "Stays Put"

in Rotary Kilns Equipped With

ALLIS-CHALMERS Air-Cooled KILN END



Savings in Refractory Brick Will Pay for Air-Cooled Discharge End in 2 to 3 Years!

No end warpage on rotary kilns equipped with this air-cooled discharge end. Hot end stays cool, round and rigid. No shut-downs to replace end brick. In addition to refractory savings, you'll get . . .

MAINTENANCE SAVINGS . . . No loss of valuable production time to replace end brick! Savings in brick, labor and down-time will pay for air-cooled end *several times over* during life of kiln.

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Air-Cooled kiln end can be installed on kilns now in service. Get more facts from the A-C representative in your area, or send for Bulletin 07B6368A. Allis-Chalmers, Milwaukee 1, Wis.

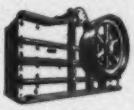
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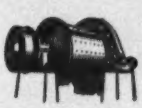
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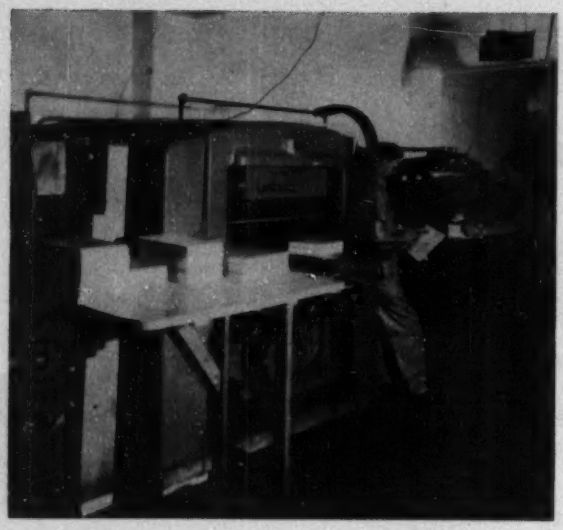

Vibrating Screens


Jaw Crushers


Gyratory Crushers


Grinding Mills


Kilns, Coolers, Dryers



Seasoned photocopy paper is cut into sheets or slit into rolls.

Photographic Sensitizing

Photocopying permits many reproductions by blueprinting or using diazo equipment without wearing out originals. Here's how contact photocopy paper is made.

Photocopying can be distinguished from other methods of reproducing drawings and illustrative material by the fact that it is the only process that can actually improve legibility of the subjects photographed. No special inks, papers or other materials are required.

Reason for this is mainly photocopy's far greater contrast characteristics.

Today, photocopying is regularly being used to make a copy of original drawings from which, over a great period of time, very large numbers of reproductions may be made in blueprinting or diazo equipment. This makes it possible to place all original engineering drawings in immediate storage, instead of having to use them repeatedly to the point of destruction through wear.

Until recently, photocopying had been limited by the fact that the camera used had to be proportionately bigger as larger and larger drawings were needed. A new Peerless camera makes possible reduction ratios up to 6:1.

The accompanying flowchart and pictures describe the coating of photocopy paper as done by Peerless Photo Products Co., Shoreham, N. Y.

► **Solution Preparation**—Measured amounts of gelatin and the appropriate soluble halide salt (may be sodium or potassium bromide or other, depending upon type of emulsion being made) are introduced into a measured amount of *cold* distilled water. The mixture is kept cold for a period long enough to permit the gelatin to swell, and the temperature is then raised to a predetermined point and stirred until all ingredients are in solution.

► **Precipitation**—An accurately measured amount of silver nitrate is introduced into the mixture with stirring. The silver nitrate reacts to form silver halide crystals. Due to the presence of the gelatin which forms a protective colloid, the crystals are extremely minute and form the light sensitive elements of the emulsion. Subsequent treatment of the emulsion is designed to modify the structure and constitution of the crystals.

► **1st Digestion**—During first digestion the emulsion is held at a closely-controlled, usually moderate temperature and stirred. Function of this step is to increase the speed (light sensitivity) of the emulsion and to modify its contrast. During this stage, the silver halide grains are slightly soluble due to presence of the alkali nitrate resulting from the reaction of the silver nitrate and alkali halide, and the silver halide grains change in shape and size distribution.

► **Shredding**—The solidified cake of emulsion is removed from the kettle and placed in a cylindrical container fitted with a perforated bottom, through which it is pushed with a hydraulic plunger and cut into strings or shreds, known as noodles.

► **Washing**—During washing, cold water passes down through the bed of noodles and slowly removes all soluble salts from the emulsion.

► **2nd Digestion**—Emulsion is remelted and held at a predetermined time and temperature. This step has for its purpose further increase of emulsion speed and contrast modification. Reaction here is chemical. With the soluble salts removed, a reaction between the silver halide and minute amounts of sulfur compounds naturally present in the gelatin can take place. Result is that minute specks of silver sulfide form on the silver halide grains which, in some manner not too well understood, modifies their light sensitivity.

► **Remelting**—The emulsion is prepared for coating by remelting, bringing to a predetermined temperature and adding the coating agents or "finals." These ordinarily comprise small amounts of a wetting agent to insure uniform wetting of the paper or film by the emulsion and a hardening agent.

► **Paper Coating**—Prepared emulsion is filtered into a reservoir from which it flows into a water-jacketed coating pan.

At the time of coating, the emulsion consists of only about 7 percent solids and it is quite fluid. To secure smooth, uniform coating it is necessary to chill the coated emulsion to a jelly as quickly as possible.

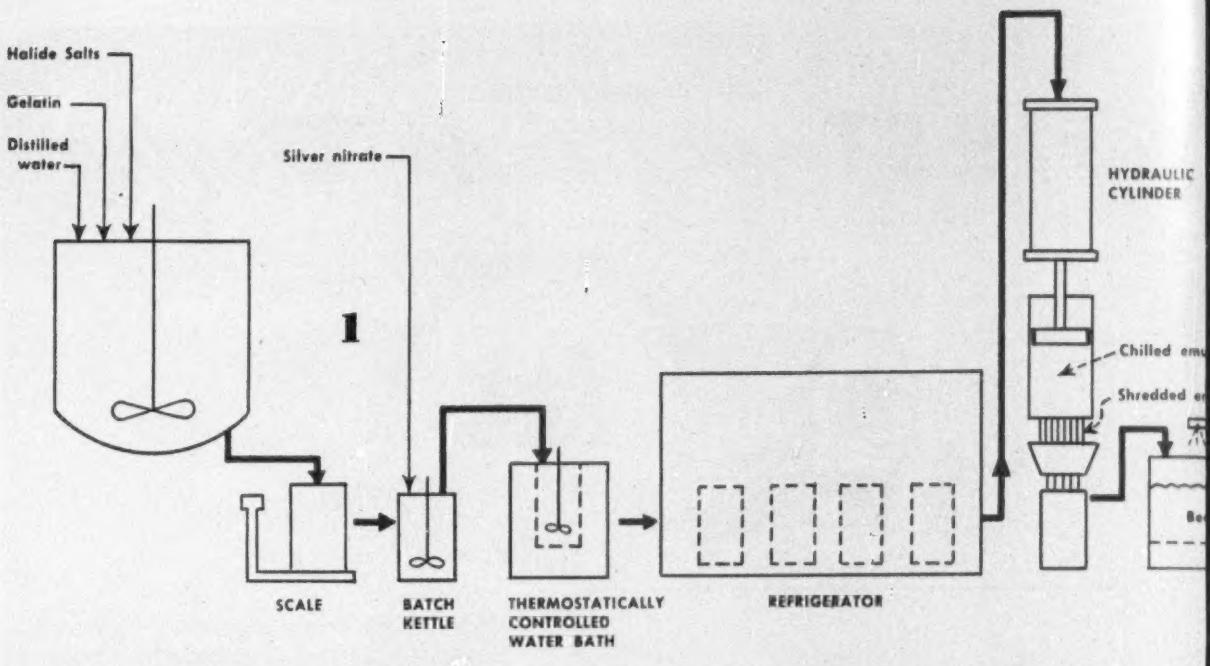
► **Drying**—Sticks supporting festoons of coated paper are carried slowly down the drying alley on chains and accurately conditioned air is blown down on the loops to dry the emulsion. The drying tunnel is divided into several zones, in which the temperature and humidity of the incoming air is separately controlled. As drying proceeds, the temperature of the air may be raised.

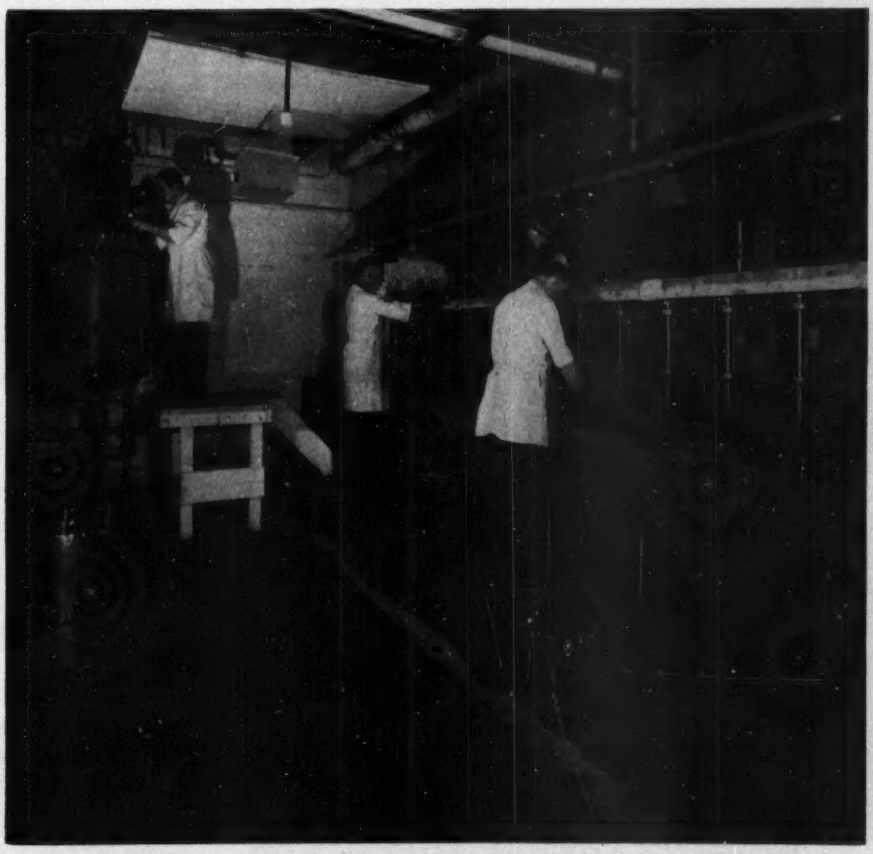
In addition to accurate conditioning of the drying air, thorough filtering to remove all dust particles is necessary.

► **Rehumidifying**—A short re-humidifying stage is provided to conveniently adjust and control the amount of moisture in the finished sheet.

► **Seasoning**—Seasoning in the store-room is a necessary step in the manufacture of photographic materials. This room is conditioned to 70 deg. dry bulb and 50 percent relative humidity. In about two weeks, all buckling of the stock due to wetting will have disappeared and the photographic characteristics of the emulsion will have come to equilibrium.

Final step is physical inspection and wrapping, after which the material may emerge into the light.

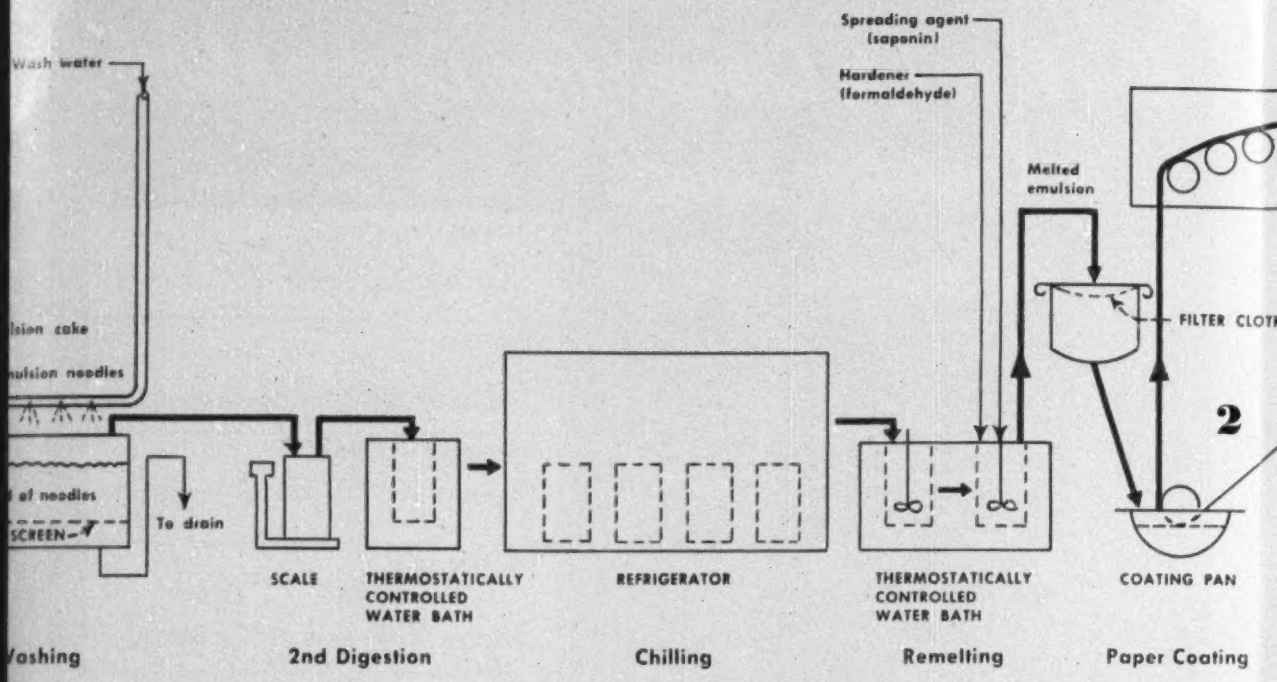


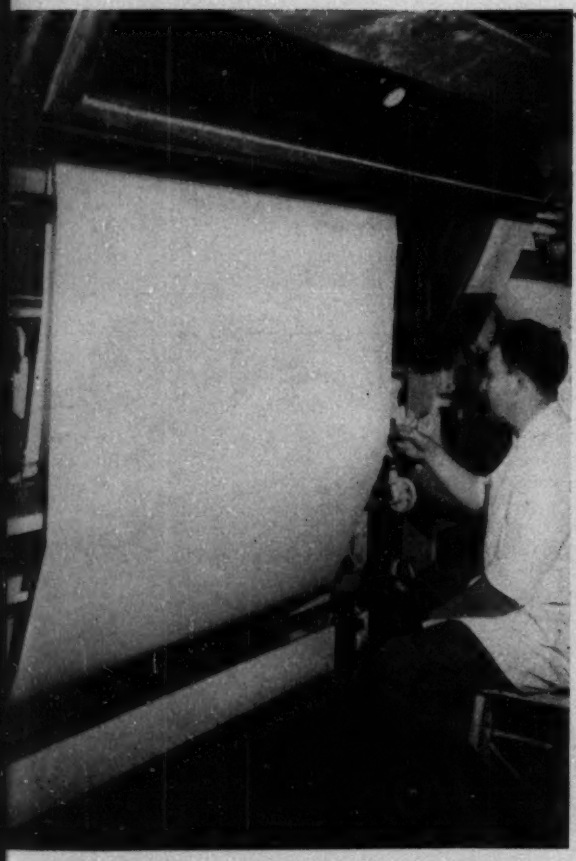


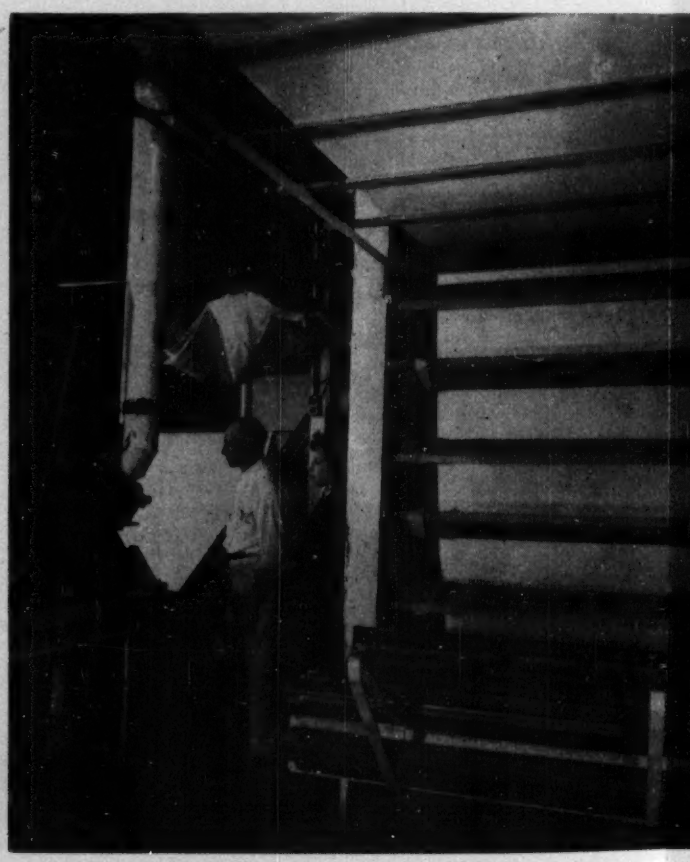
1 Precipitation and first digestion steps take place in this room. Silver nitrate is added to the emulsion and stirred. Digestion increases the light sensitivity.



2 Paper to be coated passing arou
coated emulsion must be chille

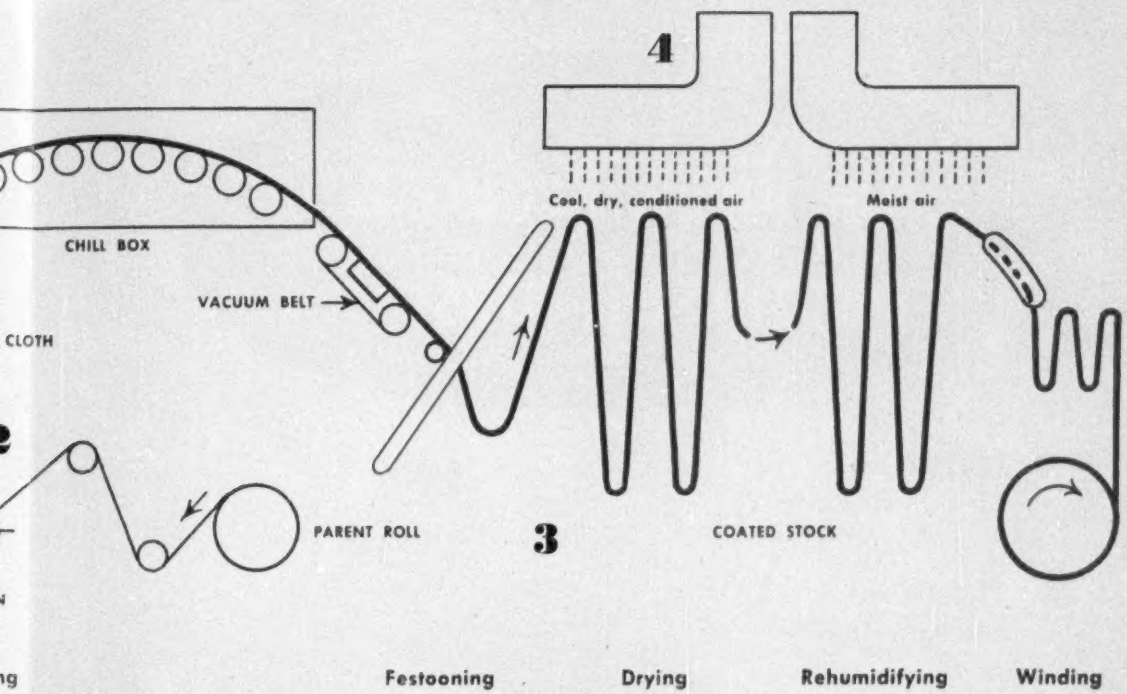






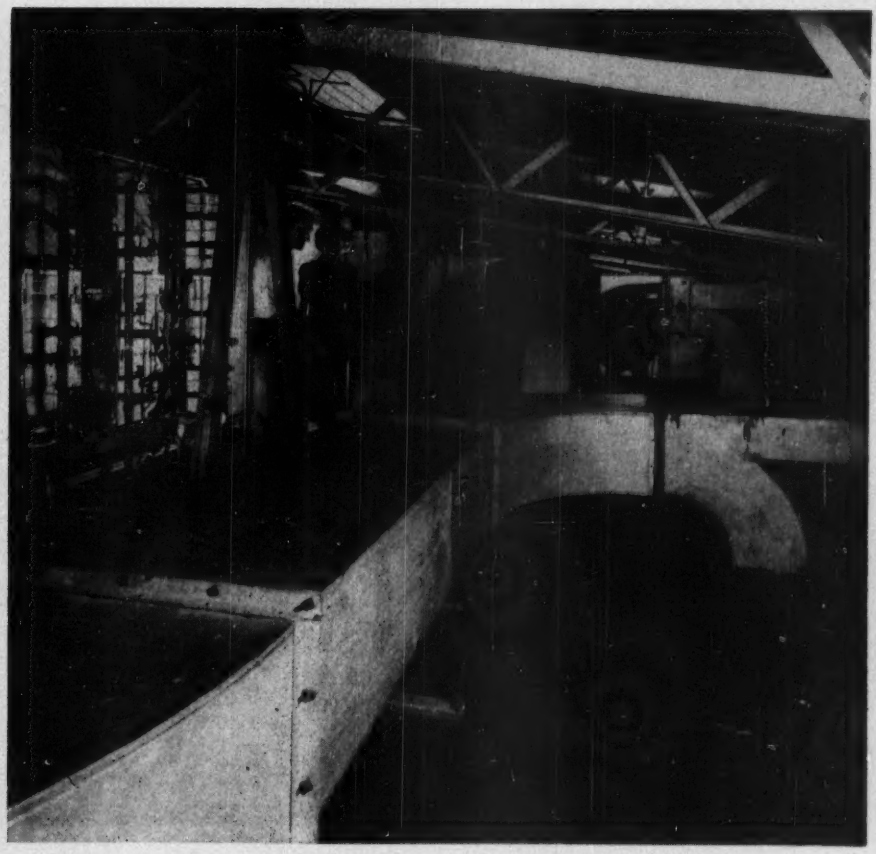
d the coating roller. To secure a smooth and uniform coating, the
to a jelly as quickly as possible.

3 Coated paper leaving the vacuum belt is automatically formed on moving stick
the drying alley. Exit end of chill box and festooning its shown at left.





sticks for passage through
t.



4 Part of the conditioning and distribution system of one section of the drying alley. Consitioned air dries the emulsion. Thorough filtering removes dust particles.

Save Time... Reduce Labor ON THESE 6 JOBS!

1. **TO FILTER**
   a solid from a suspension.
2. **TO DRAIN**
   a solid by removal of surface moisture.
3. **TO DEHYDRATE**
   a solid by displacement of water or other liquid by miscible solvent.
4. **TO CLARIFY**
   a liquid by sedimentation.
5. **TO THICKEN**
   a suspension by a partial removal of a liquid.
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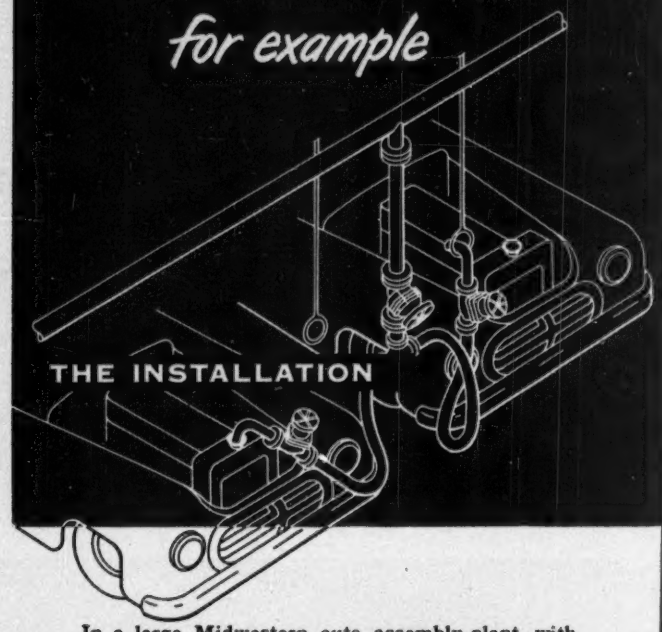
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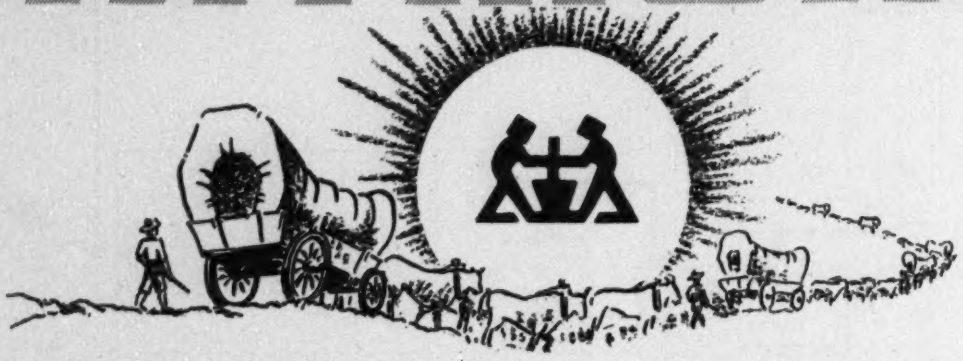
CRANE VALVES

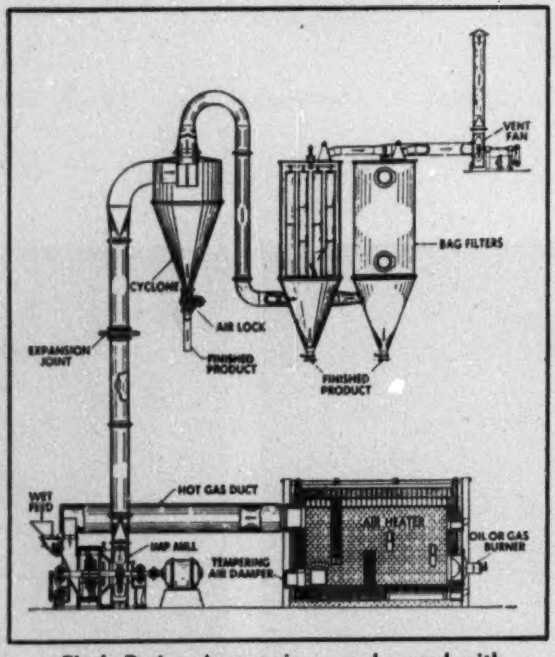
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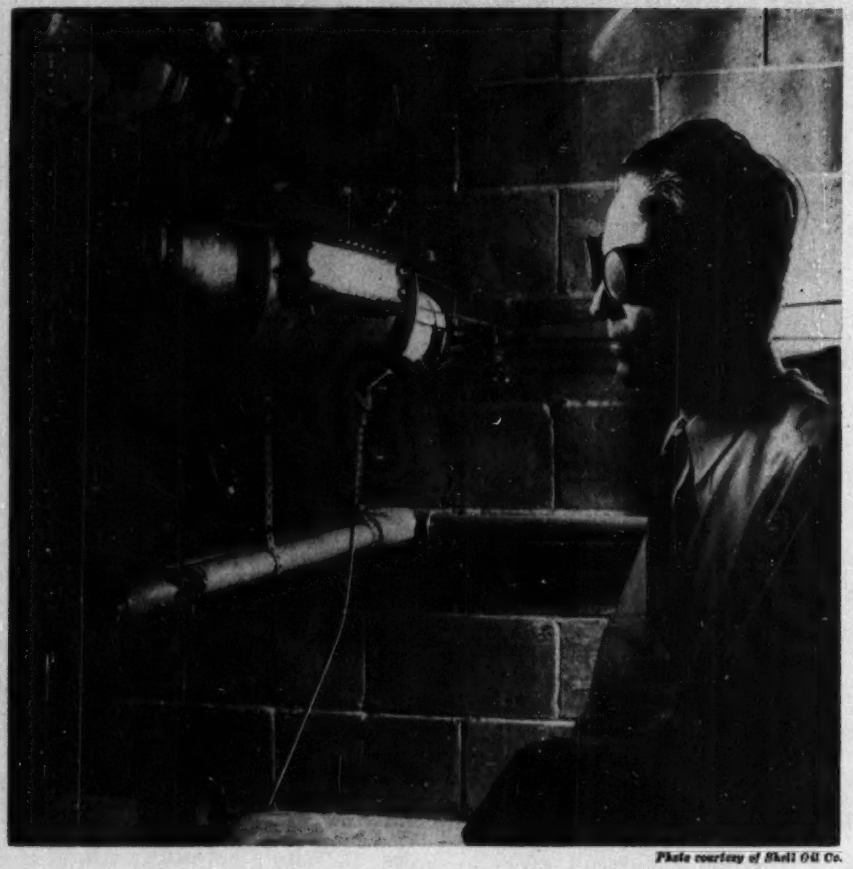


Photo courtesy of Shell Oil Co.

How Not to Be "Just Another Researcher"

T. F. CATHEY

The young technical graduate today has a fairly comprehensive knowledge of the basic technology in his field. He is crammed with facts and figures.

But he has had so little contact with live industry that he finds difficulty in knowing *how* to apply this newly acquired knowledge in industrial research. (The term "industrial research" is used in its broadest sense to include all phases of systematic problem solving in research, development, and production.) Although academic problems offer invaluable practice in problem solving, they cannot approach the complexity of most problems in industry. The difficulty is that they do not permit an understanding of some of the factors—like communications and human relations—that must be considered.

The young graduate has solved many academic problems. Yet frequently he has not developed a realization that a definite general pattern applies to all problems. Those of us who have been in industry a few years recognize that there are certain fundamental concepts that can be applied regardless of the field or the industry.

These concepts form the basis of modern industrial research. They are the language and the channel through which ideas and thoughts are handled for the systematic solution of research problems.

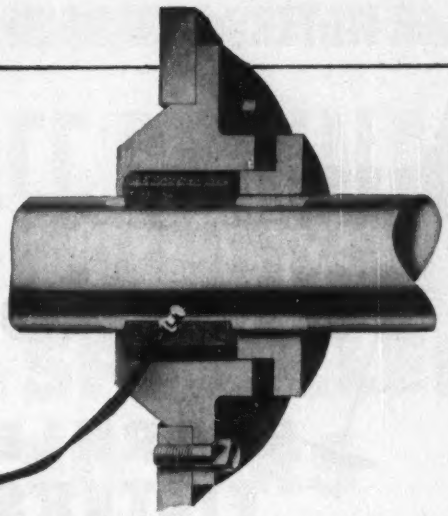
T. F. CATHEY is Supervisor of Chemical Research at the American Hard Rubber Co. in Butler, New Jersey. *Although this article is addressed to the fledgling engineer in research, we believe that experienced engineers, too, can profit from his practical tips. This article is an expansion of a section of a paper prepared in 1952 by the author while attending a graduate course in "Industrial Development and Research Organization" at Columbia University, School of Industrial Engineering and Management."*

How to Get Off to the Right Start

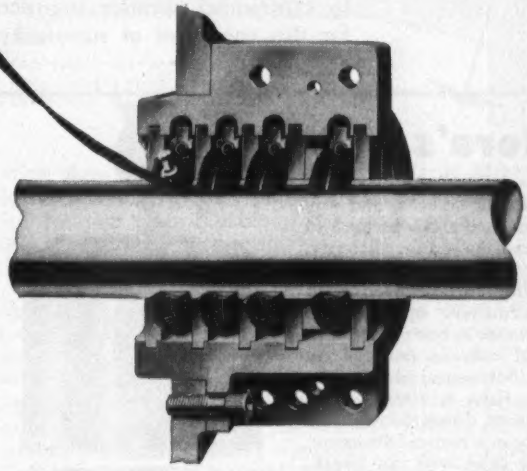
Define and delimit the problem. The first concrete step toward the solution of a problem is to define it and to set its bounbdaries. The defini-

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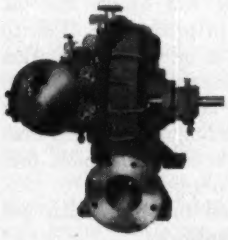
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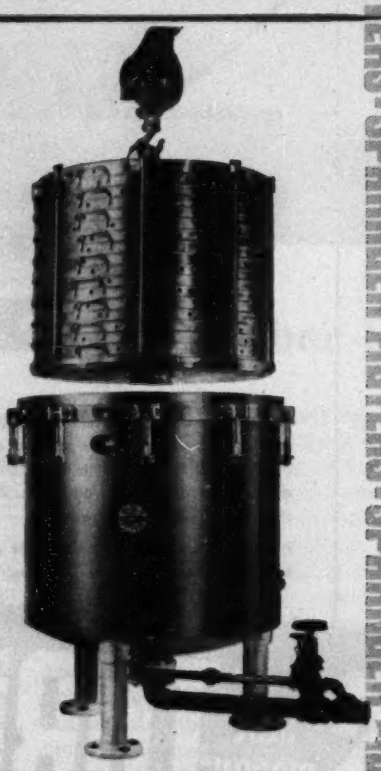
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tion must not only include the technical aspects of the problem but also the over-all objectives. That means a clear understanding between top management and the research division with regard to results the company anticipates from each research project. Management cannot expect its researchers to think "company-wise" unless it clearly defines the objectives of each research project as well as its research program as a whole.

Select the research method and organization after careful analysis of the problem.

The key word in this statement is "after." How often do we see a problem assigned to a research group? A more scientific approach is to assign a research group to a problem. This approach can only be accomplished by setting up the research method and organization *after* careful analysis of the problem. If the problem analysis calls for three chemical engineers, two organic chemists, one bacteriologist, and one psychologist, that is exactly the research group that should be assigned to the problem.

Get a clear-cut understanding of your responsibility and authority concerning the problem.

This is a fundamental rule that should apply to all industrial activity.

Get a clear-cut understanding of individual responsibility for each phase of the production and sales work connected with the problem.

Arrange to spend some time discussing the problem with the production personnel who will handle the job if it is going in production. Talk to the sales people in your organization who are most interested in the project. Nothing can bring more quickly a clear understanding of a problem than frank discussion among research, production and sales personnel.

Understand that the dollar bill is your yardstick.

It's obvious that management must in the long run expect a return on every dollar spent. So, for every dollar you spend, be prepared to explain how the company will ultimately make a profit.

How to Communicate Effectively

Arrange for interchange of ideas; one man alone will eventually run out of ideas.

This is one of the most important

concepts in scientific problem solving. An informal discussion of problems among workers of widely varied experience can often produce important and unexpected ideas. On more than one occasion the background idea for solving a problem has come from the least expected source—a foreman in the factory, a non-professional laboratory assistant.

Set up language structure so that you and the person to whom you are talking will be in agreement.

This sometimes is difficult for the research man when he is dealing with non-technical personnel. He must always try to keep in mind the background of the person to whom he is talking. He should also know the use to which the person will put the information being presented.

Plan your conferences; try to anticipate questions.

Generally the man who seems to say the right thing at the right time is the man who has thoroughly thought through a program and planned his approaches. I have seen research directors review their presentations before members of their staff almost in the form of a rehearsal. When these men walked into a conference room they were never on the defensive and, if required, they could "take control."

Don't accept the word of any worker, foreman or supervisor.

The responsibility for all facts is yours. This concept was brought home several years ago by a tough but competent plant manager. An engineer had been assigned to him on a trouble shooting job. The primary objective was to detect and remove certain batches of defective raw material from the production line. The engineer had failed to detect some of the defective batches and as a result, the entire production line was shut down. He had failed to detect the bad batches because a foreman had told him that certain lots of the raw material had been checked and found satisfactory and the engineer casually had accepted his word. As the plant manager put it, "A technical man must not depend on the thoughts or opinions of foremen or other personnel. He must get the facts!"

Don't accept without question the hypotheses of any supervisor, vice-president, or other person in authority.

This is a concept that young research workers usually find difficult to prac-

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FREE DRAINAGE IN SPARKLER FILTERS



Cross-section of individual plate, showing perforated metal screen, filter media, and filter cake.

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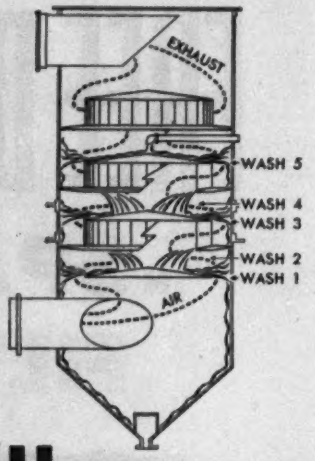
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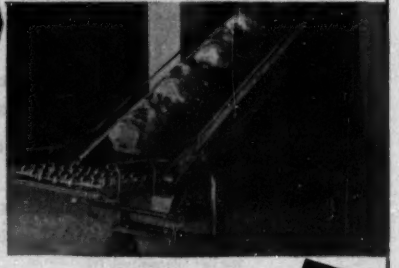


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tice. They have a tendency to look on authority and accuracy as synonymous. They are not; they are only related. Those in authority are generally more accurate more of the time, but they make mistakes, too. This just points out the necessity for careful evaluation of all hypotheses regardless of source.

Consider the suggestions of everyone in the organization regardless of his position.

The welder in the chemical plant may not be familiar with any of our concepts of scientific research; yet sometimes because of his experience he makes observations that may prove worthwhile if properly evaluated.

Don't try to sell an idea for action until you have tried to anticipate and answer objections to the idea.

Certainly one of the important functions of a research man is to sell good ideas to his boss and his management. It may appear incredible that *good* ideas have to be sold. But, they must; they are in competition with many ideas from many sources. Therefore, a sales approach should be carefully planned to present the advantages of the idea. In planning this approach you have to coldly consider the disadvantages of the idea. Naturally, if the disadvantages outweigh the advantages the idea should be dropped.

Keep a quantitative record of your progress and let your boss know about it.

The key word in this concept is "quantitative." The boss should know how much time and money has been spent on the problem and if the expenses have brought anticipated results. It is not enough to report progress as "excellent." You must define results in terms of time and dollars.

Let your boss know if you get stuck.

The basis of scientific research is teamwork. Unless you discuss your difficulties immediately the efficiency of your team will be lowered. Perhaps your boss can give the answer you require. If not, it is his responsibility to see that all available technical "know-how" is brought to bear on the specific difficulty. Nothing is more disconcerting to the research director than to find that a chemist has been spending hours or days on a difficulty that could be answered in two minutes by a mechanical engineer.

Your Management wants to know...

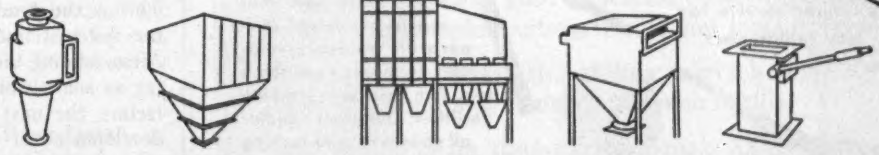
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Don't confuse requests for your opinion and requests for facts.

If you are highly regarded in your organization, management will occasionally ask for your opinion on various matters. However, at other times management wants the cold, hard facts and is not interested in your opinion. If management asks for data on the relative merits of wood and cork for a particular application, don't say "Judging from my experience on related materials, I think cork would be better." Get the facts; make tests if necessary. Then say, "Here are the facts."

Understand that the only product of a research organization is information, best presented in the form of a written report.

A project should not be considered complete until a report has been written. The writing of reports seems to be one of the most difficult and unpleasant tasks of a young research worker. Yet it is one of the most important. It is important to management that they know what is going on behind the closed doors. It is also important to the research organization that management knows of its activities. The written report serves as a factual advertising medium whereby the research department can justify its existence. At the same time it serves as an advertising medium for the individual worker. The research man should use this means to make his abilities better known to management.

How to Develop an Hypothesis

Don't make a move without a hypothesis, based on observation and analysis.

This is the fundamental concept in the systematic solution of problems. After defining the problem, and making an analysis of its basic theoretical factors, the next step should be the development of a hypothesis by intuition. A critical experiment should then be designed which will either prove or disprove the hypothesis. These steps form the basis of what we know as a scientific method.

Think in terms of cause and effect.

One of the quickest ways for a young researcher to go astray, and incidentally lose favor with his superiors, is to suggest a solution to a problem without having a definite reason why

he thinks the solution will work. It seems evident that this concept should apply to research as to all functions requiring a logical approach. Yet it is surprising to observe how many young researchers will suggest a solution to a problem without having a definite reason why the solution will work. Too often a suggestion is made that the temperature be raised (or lowered) without first formulating an hypothetical relationship between cause and effect.

Be positive that manufacturing instructions are being exactly followed when working on a production trouble shooting job.

It would be humorous if it were not pathetic to recall the number of times a particular formulation or process has been unjustly blamed for production difficulties. For example, in one instance a specific rubber formulation had been in production for 20 years. Once when blisters began to occur in the finished product, it was suggested that the research department develop a more suitable formulation. It was later found that the difficulty had resulted from a change in extrusion temperature by an extruder operator. When the temperature was adjusted to the value specified in the manufacturing instructions the difficulties disappeared. It should be axiomatic that the first step in solving a production trouble shooting job is to see that manufacturing instructions are being exactly followed.

Work both from beginning and end of production line on trouble shooting jobs to determine causes of problem.

This is not an intuitive concept, but one that experience has shown to be useful. If each phase of the production line is carefully studied after first studying the final few phases of the line, often correlations can be seen that would otherwise be missed or not seen immediately.

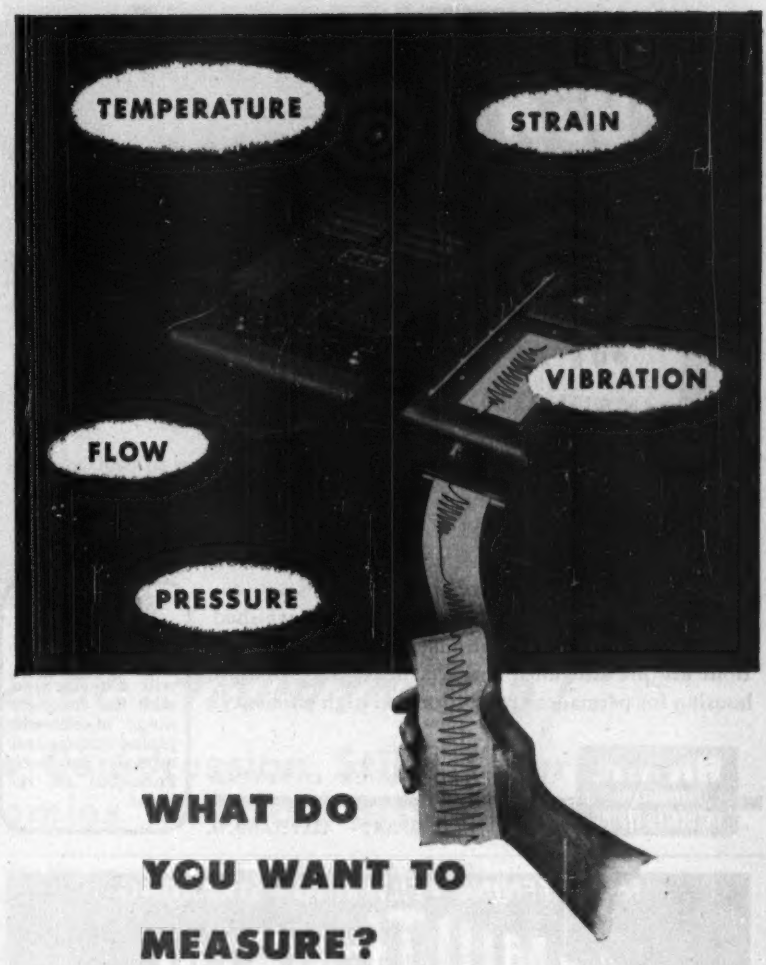
How to Develop Your Data

Design critical experiments for all hypotheses.

The aim should be to design an experiment that will give the correct answer with the least expense. The answer must be "yes" or "no"; will it work or won't it?

Move in jumps rather than steps.

Set up as many hypotheses as appear of interest, and then experiment on as many as possible simultaneously. This approach generally gives the



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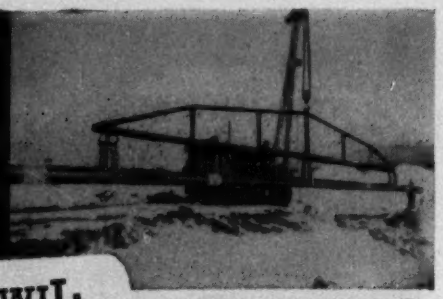
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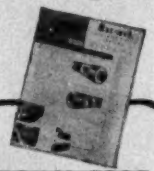


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answer more quickly and at the same time develops more information.

Use control tests where possible. When evaluating a new composition or process it is usually easy to run a control test using an established composition or process as a standard. Control tests of this sort often reveal any deviations from specified conditions that might have occurred during the evaluation.

Keep ultimate end use of product in mind. A process may be satisfactory for manufacturing caustic soda for the paper industry. But, the same process may not produce caustic of the desired purity for the rayon industry.

Decide what to measure, how to measure it, and how to manipulate measures to answer questions. Usually not enough thought is given to this phase before an experiment is performed. Careful consideration of these points in designing an experiment will give answers more accurately and with less effort.

Establish criteria for evaluating results. Usually a few definite factors are of critical importance. Criteria for evaluating the results are normally based on a study of these factors.

Establish limits of accuracy. The limits will depend upon the known degree of control of the experiment, the intended use of the data obtained, and the economic factors involved.

Use principle of measurement. It is important to establish a quantitative basis for decision. The results should be in terms that permit quantitative evaluation—numbers, ranking, quantity, and the like.

Use operational principle. It is not enough to merely specify technical experimental conditions. Other factors that relate to total objective, such as observer, values, environment, etc., must be recognized.

Use feed-back principle. That is, use values from the process as a signal to measure the error and correct for it. By oscillating between left and right, it is possible to determine functional relationships and feed back information to get on center. This serves as an effective guide toward the objective.

Use cooperative principle. Present day research problems de-



fresh water...from the sea!

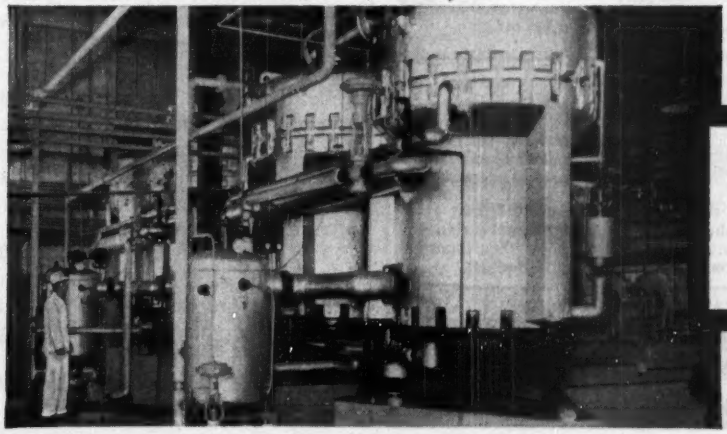
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This plant is one of the largest compression still installations in the world, producing over 100,000 gallons of pure water daily.

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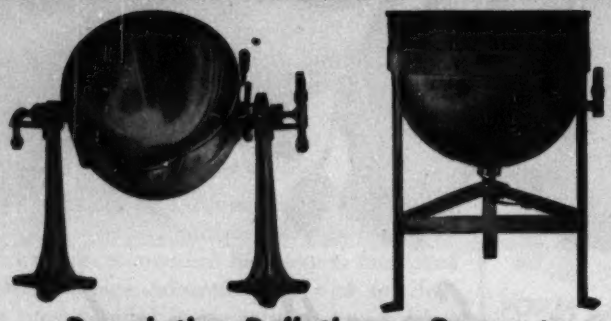
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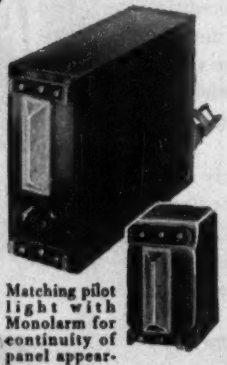
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mand that they be considered from many angles. Effective use can be made of a committee of members from various departments in an advisory capacity.

Use practical principle.

That is, determine and frequently review effectiveness of methods for attaining objectives. Also consider feasibility of attaining objectives.

How to Arrive at a Conclusion

Consider original data as evidence for inferences of various kinds.

The following four characteristics of original data must be considered:

1. Numbers representing the numerical values of the measurements. Both the accuracy and relative values of numbers given in the original data must be considered.
2. Description of the condition under which each measurement was made, and details of the method of measurement.
3. Human element. Notes should tell who made the individual observations. The reliability of each observer must be considered.
4. Order in which numbers were taken. Sometimes important trends or patterns can be observed from this information.

Classify observed data and note similarities, differences, and relationships.

A study of these classifications will assist in the formulation of conclusions concerning the hypothesis under test. In addition, it will provide information that may be useful in the development of additional hypotheses if required.

Use theories of statistics and probability for the solution of certain types of problems where the assumption of randomness and/or regularity is valid.

The young graduate will find it worthwhile to develop a working knowledge of statistical methods for both the design and interpretation of experiments. These methods provide a scientific basis for arriving at and expressing conclusions.

The young technical graduate will find the foregoing concepts useful in making his transition to industrial research. It should be an interesting experience—in a job which is sometimes difficult, always challenging, and never dull.

YYJ SHORTS

BENEFITS

. . . And Employee Relations

Like many employers, the Husky Oil Company of Cody, Wyoming, realized that most of its workers regarded their actual take-home pay as their total salary. A novel payroll procedure was arranged to counteract this belief and to dramatize some other facts to the employees and the public.

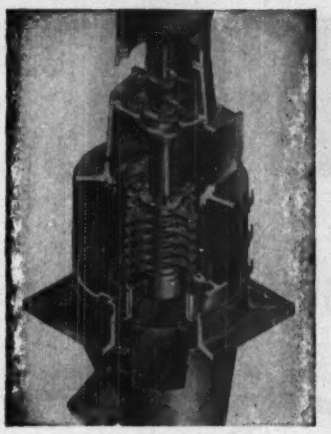
The local bank made arrangements with the Federal Reserve Bank of Kansas City to obtain $40,000 in two-dollar bills for a cash payday for Husky's employees in Cody. This collection of two-dollar bills constituted the major supply of these bills in the West, and they created quite a stir in Cody, where silver dollars are commonly used.

At 7 a. m. on payday morning, the County Sheriff and representatives of Husky pulled their cars up to the front door of the bank and some of the early risers witnessed the delivery of two large steel boxes containing some twenty thousand two-dollar bills. The armed sheriff watched the company's accounting department pay almost 200 employees their semi-monthly gross pay with the bills. The employees then paid in two-dollar bills their deductions for income tax, social security, group insurance, retirement and other deductions.

A demonstration followed, showing just how these deductions were disbursed. The cost to the company and the employees of the various benefit plans was vividly portrayed by the use of colored charts. Employees were surprised at the amounts the company was spending on employee benefit plans, and some had not realized that the total costs of workmen's compensation and employment compensation were paid for entirely by the employer. The demonstration also showed employees the direct benefits they received from the various plans.

Since more than 60 percent of the eligible employees are stockholders of the company, the meeting then became something in the nature of a report to stockholders. The company showed, by use of two-dollar bills, what its income and cost of doing business had been for the previous fiscal year. Many eyebrows were

CASE HISTORY SERIES



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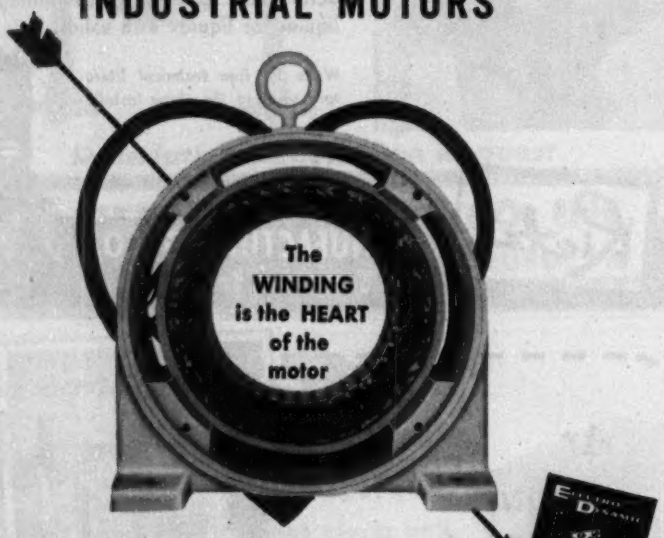
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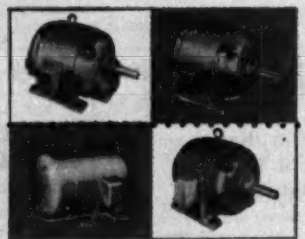
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raised when the employees saw that only one two-dollar bill was left as net earnings from a total of 50 such bills which served to represent income.

The reaction of the public to the cash payday was beyond expectations. The trail of the Husky employees' money was dramatic evidence to merchants in the community of the impact of an industrial payroll on their own business.

—*Personnel* 11/52

INCENTIVES

. . . Reduce Engineering Turnover

Of nearly 500 companies covered in a recent nation-wide survey by the National Society of Professional Engineers, 42 percent reported that they found engineer turnover a problem in maintaining an efficient engineering staff. Such benefits as hospitalization and insurance were considered effective in reducing turnover, although 81 percent of the companies said they believed that the relative importance of benefits had declined, particularly among the larger companies, almost all of which now offer them.

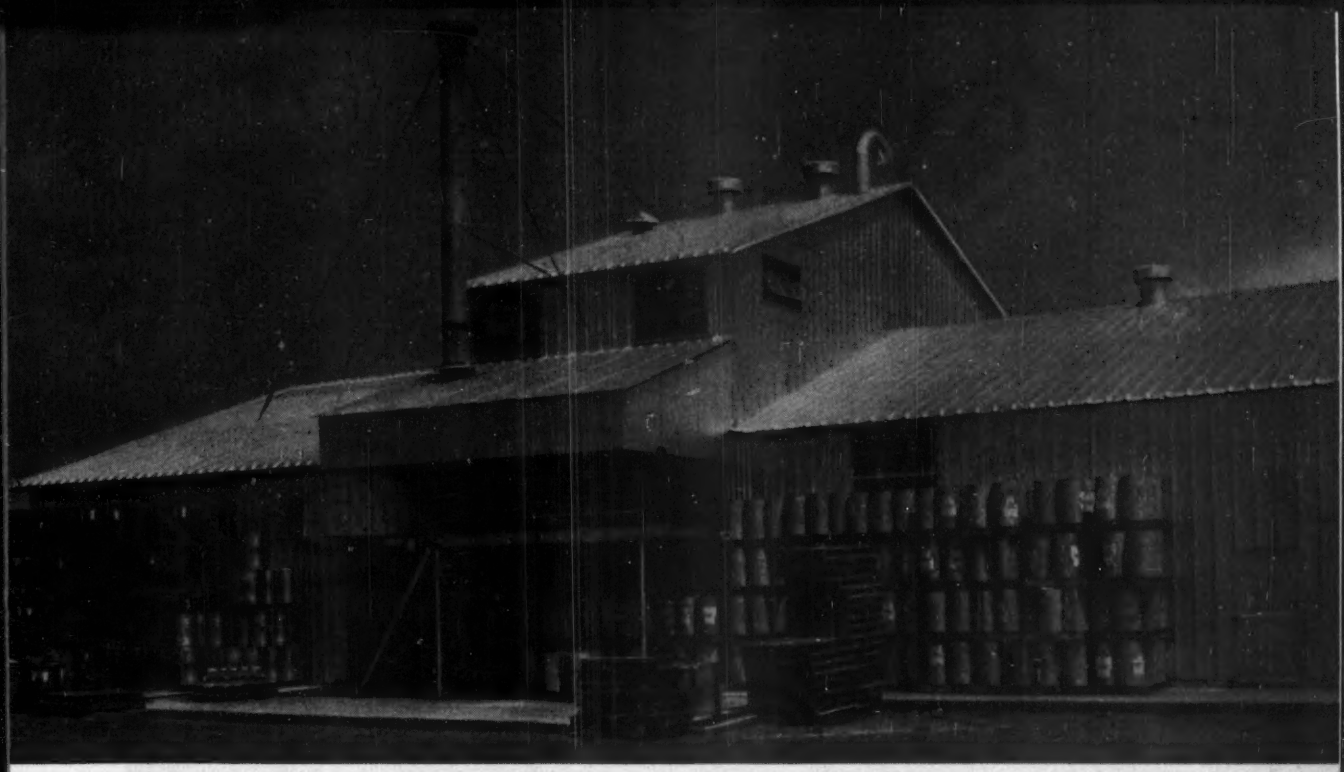
In general, incentives were believed more important than benefits. Those regarded as most effective were shown by the survey replies to be as follows: (1) opportunity for advancement; (2) stability of employment; (3) chance to receive extra training; (4) essential industry; (5) profit-sharing plan.

ADVANCED DEGREES

. . . Do They Pay?

The Ph.D. degree in science or engineering is worth about $40,000 in additional salary during the holder's lifetime as compared with the lifetime salary of the Bachelor of Science according to a survey made by the Los Alamos Scientific Laboratory. These figures represent median salaries, with half the scientists receiving more and the other half less.

These statistics indicate that upon starting work after receiving the doctorate, the chemist or chemical engineer can expect to earn about $125 a month more than he would be earning at that point if he had ac-



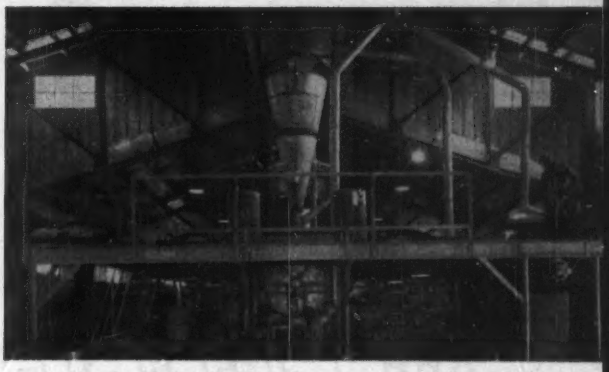
Chemical plant in Memphis, Tenn., uses this 50' x 100' x 14' Butler building with modified center section. You can get single span, combination or multiple Butler buildings in widths, lengths and heights to fit your plant specifications.

here's how BUTLER CUTS UP TO 47% off your building costs

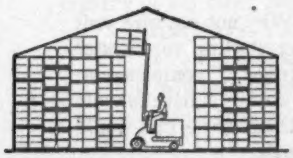
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Interior of Memphis plant shows easy adaptability of Butler buildings. Rigid frame construction with straight sidewalls and truss-clear roof assures you *full* usable space.



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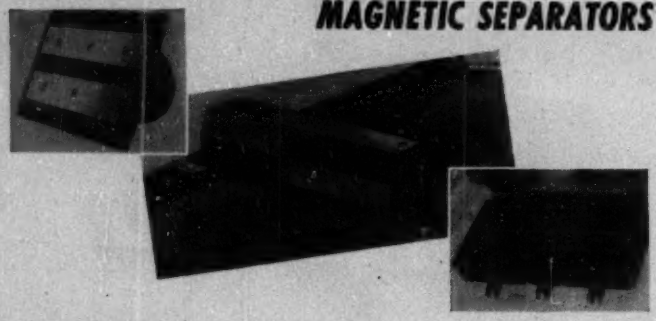
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Said the boss: "Folks will think from our ads that the grate is the only magnetic separator we make. Tell 'em about the others."

So we're illustrating our Triple-Air-Gap and Single-Air-Gap chute models and our Portable model besides our Magnetic Grate.

The air gaps in the chute models are troughed. Rolling pieces of steel, such as nuts and ball bearings, drop into the recesses. There they are stopped dead by magnetic force.

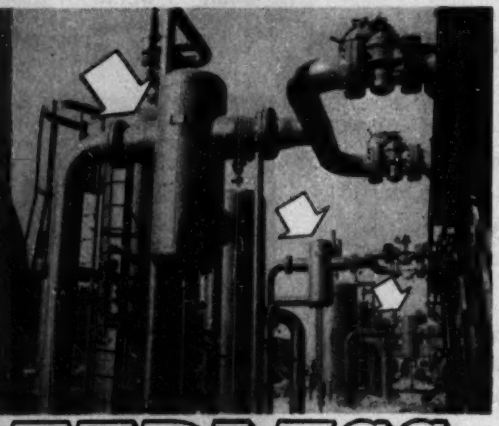
Iron and steel pieces hop out of flowing materials to impinge upon the Portable Magnet mounted over a picking table or belt.

The Magnetic Grate is placed in a hopper bottom or floor opening to catch the tramp iron in dumped or shoveled material.

Get all the details in Bulletin M-3-A.

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cepted a job immediately after graduation with the B.S. degree. The differential, it is estimated, remains rather constant over a period of years, so that in an average working lifetime the Doctor of Philosophy will earn about $50,000 more than the Bachelor of Science during the same number of years. The B.S. man, however, will have earned about $10,000 during the years when the Ph.D. was working for the advanced degree, so that the Ph.D. will show a net advantage of only $40,000.

LETTERS

. . . Cost About $1 Each

Don't take a letter, Miss Smith. It will cost an average of $1 and 3 mills if you do.

These figures, worked out by the correspondence improvement division of the Kemper Insurance Group, Chicago, were based on a study of 120 insurance and industrial offices in which dictaphones and typewriting pools (transcription departments) are used. These offices send out a combined total of 70,000 letters each month.

In some offices, where it is not considered feasible or desirable to use a typewriting pool, the costs may be even higher than $1.003 a letter, the statisticians point out. In simple terms, these are the chief expenses involved in getting out a letter:

Salary of person dictating	$0.253
Typist's salary	0.405
Employee benefits	0.015
Stationery and printing	0.063
Machine cost	0.042
Overhead (rent, light, heat)	0.041
Stamps and mailing	0.060
Miscellaneous	0.124
Total	$1.003

What can be done to cut costs? The Kemper correspondence experts suggest these answers:

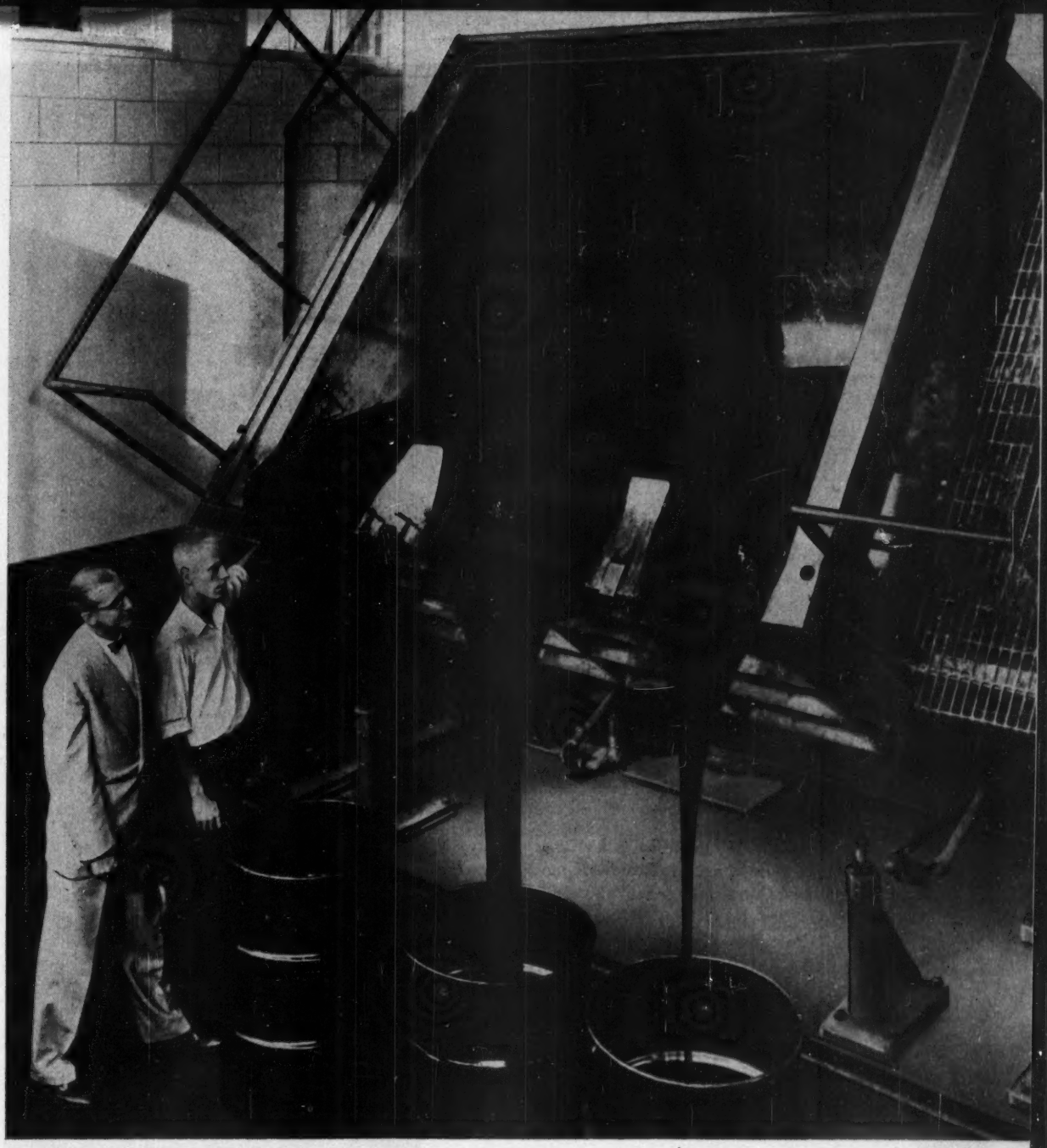
To get an answer in the same office, phone for it.

Be concise. Why not organize your thoughts before starting to dictate?

Don't sacrifice completeness, though. If you do, you'll have to write two or three letters where one would have been enough.

—The Management Review 9/52

—End



BAKER PERKINS builds world's largest color blending machine

Now in operation at the Hilton-Davis Chemical Company's plant in Cincinnati, this huge blender and flushing machine designed and built by Baker Perkins Inc. mixes 1000 gallons of flushed colors at one time. That's roughly 15,000 to 30,000 lbs., depending on the specific gravity of the colors, nearly three times the capacity of any other blender in use today. The unit weighs 21 tons and took two years to design, construct and install. ✓ ✓ You may not need the world's largest color blending machine, but you can't go wrong if you rely on the company that can build one. When you need good, dependable chemical mixing machinery that will help increase your production and keep your maintenance and operating costs low, it will pay you to consult a BAKER PERKINS sales engineer or write us today.

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MEDIUM to HIGH PRESSURE SERVICE

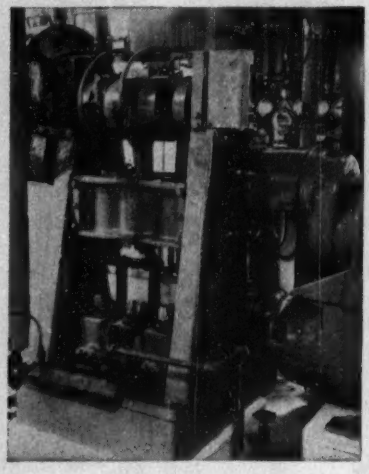
FOR AUTOMATICALLY CONTROLLED DELIVERY use an Aldrich-Groff "POWR-SAVR." This variable stroke triplex pump controls delivery from 0 to 100% of capacity at constant pump and motor speed . . . can be controlled from any remote point, manually or automatically. Power requirements are low, because consumption is directly proportional to demand.

"POWR-SAVR" pumps handle any free-flowing liquid at discharge pressures from 300 to 15,000 psi and are available in six sizes—from 2" to 6" stroke and from 5 to 125 bhp. For more information on these versatile pumps, write for Data Sheet 65.

FOR MEDIUM TO HIGH PRESSURE SERVICE several types of constant stroke pumps are available—depending upon the service involved. You may need the Inverted Vertical Triplex (Data Sheet 66), the Vertical Triplex (Data Sheet 26), or the Direct Flow Triplex or Multiplex Pump (Data Sheets 64, 64B). (All these helpful data sheets are available upon request.)

From our experience in building pumps for the chemical industry, we can—from our engineering and service files—frequently make specific recommendations to meet your chemical pumping needs. Whatever your problem, we welcome your inquiries.

Aldrich Pumps are ideal for applications involving corrosion, abrasive materials, high viscosity or high pressure. Among many liquids handled by Aldrich Pumps are: caustic solutions, fatty acids, nitric acid, acetic acid, aqua ammonia, anhydrous ammonia, as well as liquids encountered in the petroleum refining, petroleum chemical, and other industries.



This Aldrich Vertical Triplex Pump—on the job at the Burlington, N. J., plant of Hercules Powder Company—is employed to pump rosin ester in the manufacture of Abitol, hydroabietyl alcohol, used in lubricants and in the manufacture of alkyd resins. In this application pump capacity is one gallon per minute against 6,000 pounds discharge pressure.

THE ALDRICH PUMP COMPANY
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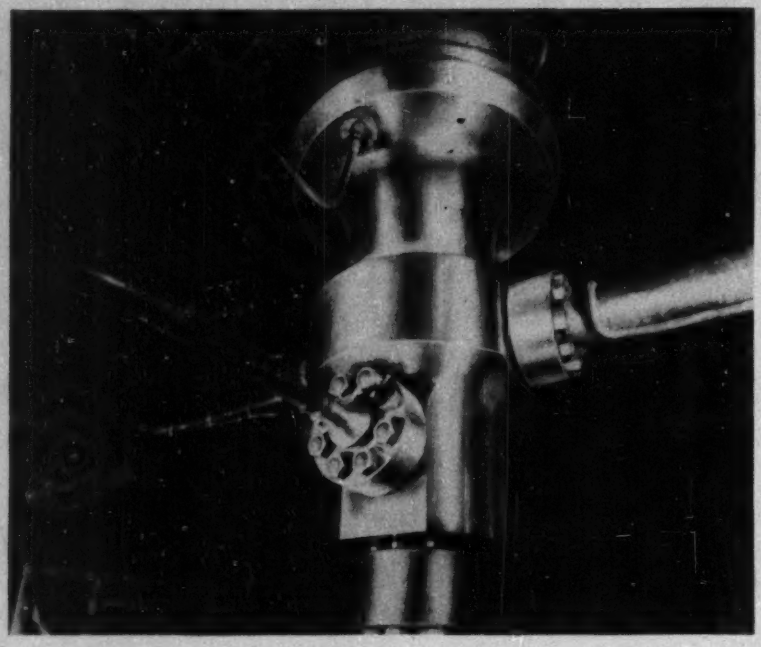
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PENNSYLVANIA INDUSTRIAL CHEMICAL CORP.



18-8 Stainless Steels

The corrosion resistance of these important materials of construction to a number of corrosives, with physical and mechanical properties and applications in the CPI.

COMMITTEE OF STAINLESS STEEL PRODUCERS
American Iron and Steel Institute

NOTE: *Last month's Corrosion Forum told what to consider in the selection of stainless steels regardless of grade. Next month, the molybdenum bearing 18-8's will appear, to be followed by the straight chromium grades.*—EDITOR

The 18-8 chromium-nickel stainless steels (normally 18 percent chromium, 8 percent nickel) have long been established in the chemical industry as materials for processing equipment of all types. They are used in storage tanks, shipping containers, conveyors, troughs, kettles, heat exchangers, fractionating towers, stills, etc.

While some other materials match these alloys in corrosion resistance, few can take the mechanical wear and abuse that the 18-8 stainless steels can. These alloy steels have excellent ductility and toughness over a wide temperature range. They offer great freedom in fabricating methods. This freedom makes possible efficiency, complex designs, light weight, and speedy construction.

BASIC ALLOY

While a number of the 18-8 stainless steel variations are designed for particular characteristics, the basic alloy of the group and the one finding most general use is Type 302. Type 302 has good corrosion resistance. It can be cold worked to high tensile strengths, is nonmagnetic when annealed, slightly magnetic when cold worked. It retains its good mechanical properties to very low temperatures.

Addition of silicon to the Type 302 analysis (Type 302 B) improves resistance to scaling or oxidation at high temperatures. The silicon (2-3 percent) gives a scale that adheres better. This is an especially desirable feature in temperature cycling operations.

FREE-MACHINING TYPE

For those parts which require a great deal of machining in their manufacture, a free-machining 18-8 stainless steel has been formulated. Type 303 has a machinability rate equal to approximately 60-70 percent of Bessemer Screw stock. This compares to a rate of almost 45 percent for the other 18-8 stainless steels. Its free cutting qualities aid in chip control. And Type 303 has less tendency to gall or seize. This combination of reduced galling with easy machining characteristics makes it an excellent material for valve or pump parts or for similar equipment in which moveable steel surfaces are in contact. Type 303 is slightly less corrosion resistant than Type 302, though the difference is scarcely measurable under most conditions.

CARBIDE PRECIPITATION

Type 302 with 0.08 to 0.20 percent carbon precipitates chromium carbides when heated and held in the "sensitizing range" of 800-1,600 deg. F. Such carbide precipitation may become critical during welding since an area behind and along side the weld will be somewhere in this temperature gradient. For certain service media this area might then be vulnerable to intergranular corrosion. It is necessary to anneal Type 302 after welding to return the chromium to

Effect of Temperature on Properties of WROUGHT Chromium-Nickel Stainless Types

AISI Types		302	302B	303	304	309	310	321	347
Creep strength,	1,000° F.	17,000	——	——	17,000	15,900	17,000	18,000	19,000
annealed, psi.	1,100° F.	12,000	——	——	12,000	11,600	13,000	13,000	14,000
(1% set in	1,200° F.	7,000	7,000	——	7,000	8,000	9,000	8,000	8,200
10,000 hrs.)	1,300° F.	4,000	4,500	——	4,000	4,500	5,000	4,500	4,600
	1,500° F.	1,200	1,000	——	1,200	1,000	1,000	850	1,500

A.I.S.I. Steel Products Manual, Section 24, April 1950.

RESISTS HOT ACETIC ACID and CHLORIDE VAPORS AT 158 TO 284 DEG. F.



HASTELLOY alloy expansion joint

This HASTELLOY alloy C expansion joint is constantly exposed to acetic acid vapors saturated with acetyl chloride and containing small amounts of chloracetic acid. Alloy C is practically unaffected by these corrosive vapors at temperatures of 158 to 284 deg. F. Used at the top of a 24-foot distillation still, the joint is also elastic enough to compensate for the almost half-inch growth of the heated tower.

HASTELLOY alloy C and the other two grades of this nickel-base alloy—alloys B and D—are excellent construction materials for all types of processing equipment that must resist corrosive attack. In addition to their unusual corrosion resistance, alloys B and C have high mechanical strength and are available in both cast and wrought forms. Alloy D is available in cast form only. All three alloys are readily fabricated by most common methods. Fill out the handy coupon below for the whole story on these alloys.

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Please send me the new edition of your booklet, "HASTELLOY High-Strength, Nickel-Base, Corrosion-Resistant Alloys."

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solution and restore full corrosion resistance.

Type 304, however, with its carbon held to an 0.08 percent carbon maximum is often used where extensive welding must be done in fabrication of equipment. Limiting the carbon content increases the time required to accumulate harmful carbides. Type 304 may usually be welded without reducing corrosion resistance below the requirements of ordinary service even though the part will not be annealed after welding.

In applications where corrosive conditions are particularly severe so that the weld-effect zone must be practically free from precipitated carbides, it may even be desirable to go to Type 304L, a 0.03 percent maximum carbon modification. Extra heating in the 800-1,600 deg. F. range because of peculiarities of the welding required may indicate the use of Type 304L.

It should be noted, however, that precipitated carbides do not limit the use of equipment for a great many media. Furthermore, equipment may have to be used in a process which

Physical Properties & Working Characteristics of WROUGHT Chromium-Nickel Stainless Steels in the Annealed Condition

AISI Type No.		302	302B	303	304	305	308	309	310	321	347
Modulus of elasticity in tension, psi		28.0×10⁶	28.0×10⁶	28.0×10⁶	28.0×10⁶	28.0×10⁶	28.0×10⁶	29.0×10⁶	30×10⁶	28.0×10⁶	28.0×10⁶
Modulus of elasticity in torsion, psi		12.5×10⁶	—	—	12.5×10⁶	12.5×10⁶	—	—	—	—	—
Density (lb./cu. in.)		0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
(gm./cc.)		7.9	—	7.9	7.9	—	—	7.9	7.9	7.9	8.0
Specific electrical resistance at room temp., microhms/cm./sq. cm.		72	73	72	72	72	72	78	78	72	73
Magnetic permeability	(Annealed)	1.003	—	1.003	1.02	—	—	1.003	1.003	1.02	1.02
	(10% cold worked)	1.10	—	—	1.10	—	—	—	—	—	—
	(Severely cold worked)	10.0	—	—	7.0	—	—	—	—	—	—
Specific heat, Btu./lb./° F. (32–212° F.)		0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Thermal conductivity Btu./hr./ft.²/° F.	(212 F.)	9.4	9.2	9.4	9.4	9.4	8.8	8.0	8.0	9.3	9.3
	(392 F.)	10.2	—	—	10.3	—	—	—	8.2	10.2	10.2
	(572 F.)	10.9	—	—	11.0	—	—	—	8.8	11.1	11.1
	(752 F.)	11.6	—	—	11.8	—	—	—	9.5	11.9	11.9
	(932 F.)	12.4	12.5	12.4	12.4	12.4	12.5	10.8	10.8	12.8	12.8
Mean coefficient of thermal expansion/° F.	(32–212° F.)	9.6×10⁻⁶	9.0×10⁻⁶	9.6×10⁻⁶	9.6×10⁻⁶	9.6×10⁻⁶	9.6×10⁻⁶	8.3×10⁻⁶	8.0×10⁻⁶	9.3×10⁻⁶	9.3×10⁻⁶
	(32–600° F.)	9.9×10⁻⁶	10.0×10⁻⁶	9.9×10⁻⁶	9.9×10⁻⁶	9.9×10⁻⁶	9.9×10⁻⁶	9.3×10⁻⁶	9.0×10⁻⁶	9.5×10⁻⁶	9.5×10⁻⁶
	(32–1,000° F.)	10.2×10⁻⁶	10.8×10⁻⁶	10.2×10⁻⁶	10.2×10⁻⁶	10.2×10⁻⁶	10.2×10⁻⁶	9.6×10⁻⁶	9.4×10⁻⁶	10.3×10⁻⁶	10.3×10⁻⁶
	(32–1,200° F.)	10.4×10⁻⁶	11.2×10⁻⁶	10.4×10⁻⁶	10.4×10⁻⁶	10.4×10⁻⁶	10.4×10⁻⁶	10.0×10⁻⁶	9.7×10⁻⁶	10.7×10⁻⁶	10.6×10⁻⁶
	(32–1,500° F.)	—	—	—	—	—	—	—	—	11.2×10⁻⁶	11.1×10⁻⁶
	(32–1,800° F.)	11.2×10⁻⁶	—	—	11.2×10⁻⁶	—	—	11.5×10⁻⁶	10.6×10⁻⁶	—	—
Max. continuous temp. without excessive scaling, ° F.		1,650	—	1,600	1,650	—	—	2,000	2,000	1,650	1,650
Melting point range, ° F.		2,550–2,590	2,500–2,550	2,550–2,590	2,550–2,650	2,550–2,650	2,550–2,590	2,550–2,650	2,550–2,650	2,550–2,600	2,550–2,600
Forging practice (initial temp. ° F.)		2,100–2,300	2,050–2,250	2,100–2,350	2,100–2,300	2,100–2,300	2,100–2,300	2,050–2,250	2,000–2,250	2,100–2,300	2,100–2,300
(final temp. ° F.)		1,700–1,750	—	1,700–1,750	1,650–1,700	—	—	1,800–1,850	1,800–1,850	1,650–1,700	1,700–1,750
Annealing temp., ° F.		Cool rapidly from 1,850–2,050	Cool rapidly from 1,850–2,050	Cool rapidly from 1,850–2,050	Cool rapidly from 1,850–2,050	Cool rapidly from 1,850–2,050	Cool rapidly from 1,850–2,050	Cool rapidly from 1,900–2,050	Cool rapidly from 1,900–2,100	Cool rapidly from 1,750–1,950	Cool rapidly from 1,850–2,050
Low anneal		—	—	—	—	—	—	—	—	1,550–1,650	1,550–1,650
Full anneal		—	—	—	—	—	—	—	—	1,750–1,950	1,850–2,050

NOTE: Wherever possible values given are from AISI Steel Products Manual, Section 24, April 1950. Where no AISI figures were available ASTM figures have been used. (Ref. ASTM technical publication No. 52A Tables II and XX.)

Chemical Composition of WROUGHT Chromium-Nickel Stainless Types

AISI Designation	302 General Purpose	302B Scale Resisting	303 Free Machining	304 Welding Quality	305 Low Work Hardening	308	309	310	321	347
						High-Heat-Resisting			Stabilized	Stabilized
Carbon	0.08–0.20	0.08–0.20	0.15 max.	0.08 max.	0.12 max.	0.08 max.	0.20 max.	0.25 max.	0.08 max.	0.08 max.
Manganese	2.00 max.	2.00 max.	2.00 max.	2.00 max.	2.00 max.	2.00 max.	2.00 max.	2.00 max.	2.00 max.	2.00 max.
Silicon	1.00 max.	2.00–3.00	1.00 max.	1.00 max.	1.00 max.	1.00 max.	1.00 max.	1.50 max.	1.00 max.	1.00 max.
Phosphorus	0.04 max.	0.04 max.	—	0.04 max.	0.04 max.	0.04 max.	0.04 max.	0.04 max.	0.04 max.	0.04 max.
Sulfur	0.03 max.	0.03 max.	0.07 min.	0.03 max.	0.03 max.	0.03 max.	0.03 max.	0.03 max.	0.03 max.	0.03 max.
Molybdenum or zirconium	—	—	0.60 max.	—	—	—	—	—	—	—
Titanium	—	—	—	—	—	—	—	—	5XC min.	—
Chromium	17.00–19.00	17.00–19.00	17.00–19.00	18.00–20.00	17.00–19.00	19.00–21.00	22.00–24.00	24.00–26.00	17.00–19.00	17.00–19.00
Nickel	8.00–10.00	8.00–10.00	8.00–10.00	8.00–11.00	10.00–13.00	10.00–12.00	12.00–15.00	19.00–22.00	8.00–11.00	9.00–12.00
Columbium	—	—	—	—	—	—	—	—	—	10XC min.

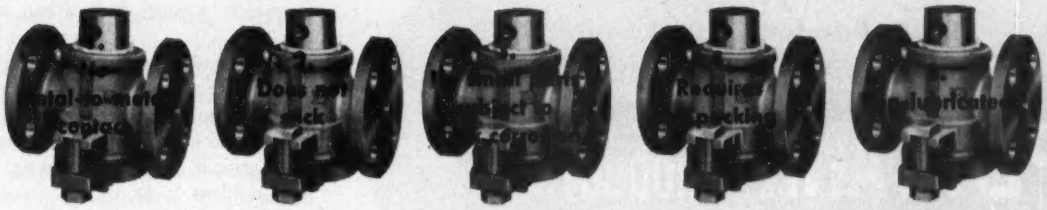
NOTE: Additional modifications of Type 347 are TS347 which has 8XC minimum of columbium, and TS347A which contains a columbium-tantalum content of 8XC as required by NPA.
AISI Steel Products Manual, Section 24, April 1950.

Representative Mechanical Properties for WROUGHT Chromium-Nickel Stainless Types

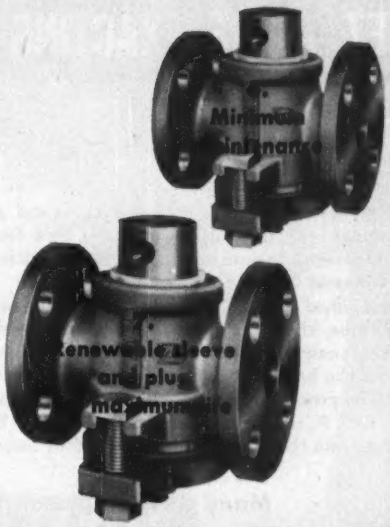
AISI Type	302	302B	303	304	305	308	309	310	321	347
Sheet & strip, annealed										
Tensile strength, psi	90,000	95,000	—	85,000	85,000	85,000	90,000	95,000	90,000	95,000
Yield strength, psi	40,000	40,000	—	35,000	38,000	35,000	45,000	45,000	35,000	40,000
Elongation, % 2 in	50	55	—	50	50	50	45	45	50	45
Rockwell hardness	B85	B85	—	B-80	B-80	B-80	B-85	B-85	B-80	B-85
Bars, annealed										
Tensile strength, psi	85,000	90,000	90,000	85,000	—	85,000	95,000	95,000	85,000	90,000
Yield strength, psi	35,000	40,000	35,000	35,000	—	30,000	40,000	45,000	35,000	35,000
Elongation, % 2 in	60	50	50	60	—	55	45	50	55	50
Rockwell hardness	B80	B85	160 Brinell	150 Brinell	—	B-80	B-83	B-89	150 Brinell	160 Brinell
Endurance limit, psi	34,000	—	35,000	34,000	—	35,000	—	—	38,000	39,000
Bars (1") cold drawn										
Tensile strength, psi	100,000	—	100,000	100,000	—	—	—	—	95,000	100,000
Yield strength, psi	60,000	—	60,000	60,000	—	—	—	—	60,000	65,000
Elongation, % 2 in	45	—	40	45	—	—	—	—	40	40
Brinell hardness	212	—	228	212 Brinell	—	—	—	—	185 Brinell	212 Brinell
Endurance limit, psi	—	—	48,000	—	—	—	—	—	—	—

A.I.S.I. Steel Products Manual, Section 24, April 1950.

The one chemical service valve



seven ways better



In the past, just one or two of these advantages were enough to justify the use of a particular chemical service valve. Now DURCO engineers have designed a valve with all seven features. With several thousand in operation in the three years since they were introduced, the list of successful applications is large and varied. If you have a troublesome corrosion problem, call the DURCO representative near you, or write The Duriron Company, Inc., Dayton, Ohio.

DURCO TYPE F VALVE



DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

*Registered trade-mark of E. I. duPont de Nemours & Co., Inc., for its tetrafluoroethylene resin.

THE DURIRON COMPANY, INC., Dayton, Ohio

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Resin-Bonded Glass Laminates
Ideal for Alum Applications

PLA-TANK® PRODUCTS
MEET THESE EXACTING DEMANDS

Custom molded from polyester resin and glass fiber, a large one-piece unlined tank 14½ feet in diameter by 8 feet high has solved the corrosion attack problem as an evaporator tank in the alum plant of Americah Cyanamid Company at Mobile, Alabama. Previously a steel tank was used, lined first with lead and then with acid-proof brick. With a pH of three, the hot liquid still attacked these linings with resulting high maintenance costs as well as constant danger of product contamination from the brick.

The process cycle involves loading the tank with alum sulfate liquor at 160° F. raising the temperature to 242° by steam coils in the tank to evaporate the liquor to dryness in four hours.

Many Advantages of New Tanks

Advantages of the new reinforced plastic tank are many and substantial. Cost is less than half the lined steel tank. Weight is under 20% of the lined steel. Corrosive attack as measured on various pilot applications will be negligible over an indefinitely long life.

These advantages are everyday occurrences on jobs where PLA-TANK Resin-Bonded Glass Laminates go to work to solve corrosion problems. PLA-TANK Ductwork for fumes and gases, PLA-TANK Vent Hoods over tanks and evaporators, PLA-TANK Stacks for resistance to both fumes and weather, as well as Tanks large or small, open or closed, can all be built to specifications for given applications in all sorts of chemical process plants or systems.

Paper Industry Interested

While the application described here is in an alum manufacturing plant, every user of alum will be interested because he shares the same corrosion problems in some degree. Papermakers, tanners, water treatment plants — everyone using alum can profit by investigation of PLA-TANK Resin-Bonded Glass Laminate Products.

FREE TECHNICAL DATA SHEETS

Upon request, without obligation, you may receive a full set of PLA-TANK Data Sheets showing chemical and physical properties, Standard Tank, Pipe, Duct and Hood units as well as data on custom built equipment.

THE Chemical CORPORATION

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"donates" carbon to the alloy. In such cases it is needlessly expensive to specify a controlled carbon stainless.

If processing equipment must be used in the sensitizing range or if thick, complicated sections must be welded and kept hot for some time, a conventional means of dealing with the problem is to use the so-called stabilized stainless alloys, Types 321 and 347.

Type 321 contains titanium and Type 347 contains columbium to control the carbide precipitation. TS347A contains columbium and tantalum to achieve the same end. These elements take up the carbon present in the alloy leaving the chromium free for corrosion resistance.

It should be noted, however, that these alloys are similar to Type 302 stainless so far as their corrosion resistance and mechanical properties at ordinary temperatures are concerned. But if the equipment must be held in the sensitizing temperature for some time, they are especially useful. Type 347 has proved particularly valuable when extremely complex weldments must be made by straight arc welding without subsequent annealing. This alloy is also often used for weld rod or filler metal when welding both Type 321 and Type 347 since columbium is not oxidized in the arc. (Since titanium is readily so-oxidized the deposit metal may not be as highly stabilized as may have been desired.)

HIGH-TEMPERATURE TYPES

Types 308, 309, and 310 stainless steels contain more chromium and nickel than the 18-8's. The addition of these alloying elements in greater quantity does increase corrosion resistance somewhat, but if more corrosion resistance is the only requirement, one of the molybdenum-bearing 18-8's should generally be specified. (These alloys, Types 316 and 317, will be discussed next month.) Types 308, 309, and 310 are usually used for their excellent heat and scale-resisting qualities, and their strength at elevated temperature conditions.

Types 308, 309, and 310 find wide use as welding rod. The extra nickel lends ductility to the weld and the extra chromium makes up for any chromium lost during welding. Thus,

good toughness and corrosion resistance in the weld are assured. Types 309 and 310 are often used for welding stainless to carbon steel. Lining of vessels by plug-welding stainless steel to carbon steel plate is often resorted to in the chemical industry to salvage corroded equipment.

Both Types 309 and 310 possess creep strengths and oxidation resistance superior to Type 302 at elevated temperatures—although for optimum strength at elevated temperatures with the standard types, Type 316 is often recommended. However, if high sulfur reducing conditions exist at such temperatures, it is better to avoid these alloys, since sulfur attacks them along the grain boundaries. The straight chromium stainless Type 446 is often recommended for this particular condition if strength at elevated temperatures is not required. Mechanical compensation can, of course, be made for its somewhat lower strength.

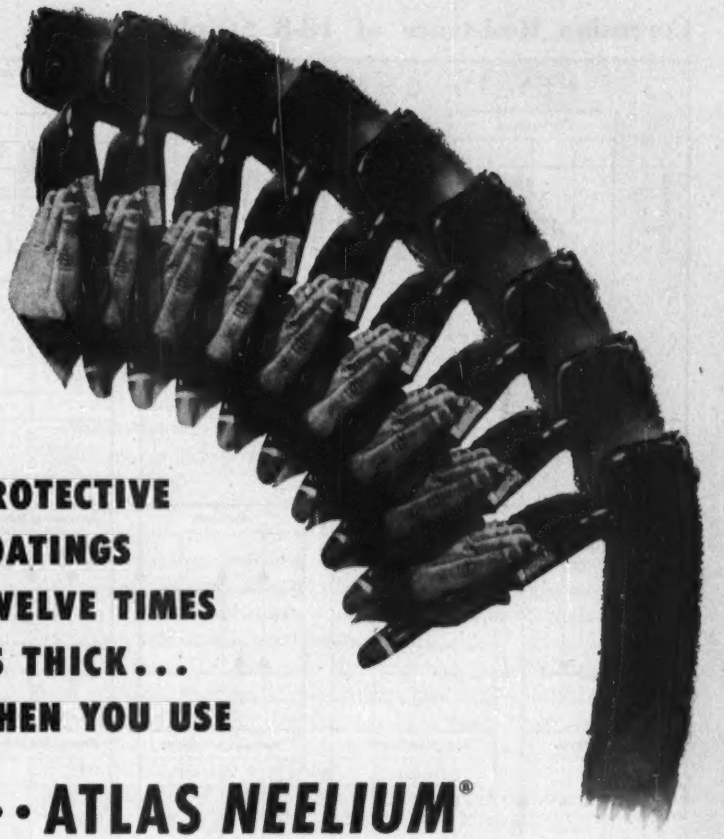
CORROSION RESISTANCE

The corrosion charts that appear with this article indicate in a general way what may be expected of the 18-8 stainless steels as a group. As can be seen, there are a great number of chemicals and operating conditions in which one or more of these alloys would seem suitable. However, combinations of chemicals often produce unforeseen results. Another thing that complicates the problem is that the condition of the stainless steels themselves can change. It is therefore especially important to run on-the-spot corrosion tests before one or more of the alloys is chosen for a new use.

Corrosion charts appearing with this article were prepared by George Nelson, Shell Development Co., Emeryville, Calif.

Typical 18-8 Applications

Single or multiple effect evaporators
Fractionating towers for organic acids, aldehydes, esters
Heat exchangers
Horizontal and vertical plate filters
Basket type centrifuges
Stills
Condensers
Homogenizers
Nitrators
Low-temperature handling and storage equipment for acetic anhydride and glacial acetic acid
Spray towers in mfg. of powdered soaps and flakes
Bagging and moving fertilizers (chutes, platforms, scales)
Ammonia holding tanks
Extremely low-temperature storage and processing of liquified gases
Steam superheaters
Pipes for fractionating gases at high temperatures
Bubble trays



PROTECTIVE COATINGS TWELVE TIMES AS THICK... WHEN YOU USE

...ATLAS *NEELIUM*®

With ATLAS NEELIUM, you apply *individual coats as much as twenty mils thick*. You use the same amount of NEELIUM as other materials, but it takes considerably less time . . . considerably less labor . . . for a more resistant coating of equal thickness.

Here is the sensible approach to a better protective coating at a lower overall cost. NEELIUM cuts labor expense which usually runs 3 to 5 times the cost of good coating materials.

NEELIUM is an ideal coating both chemically and physically. It is Neoprene based, and provides a surface that is inert and impervious to an extremely broad range of corrosives in the form of fume or splash. It resists acids, alkalies, oils, greases, salts, sunlight and weathering. NEELIUM cures at room temperature to a tough, resilient film with remarkable abrasion resistance, assuring long service under the hardest conditions.

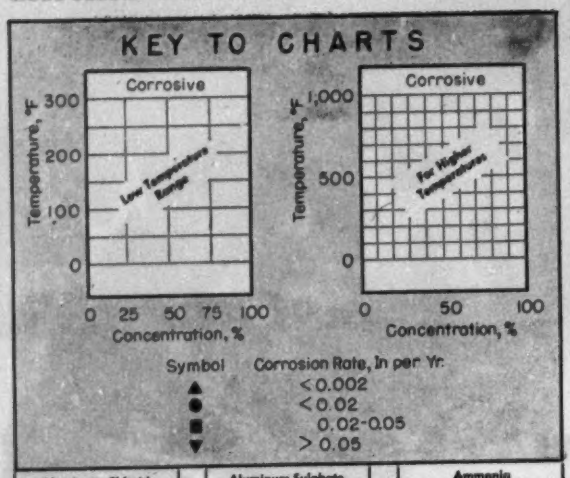
Write for full information. *Request Bulletin 7-55E.*

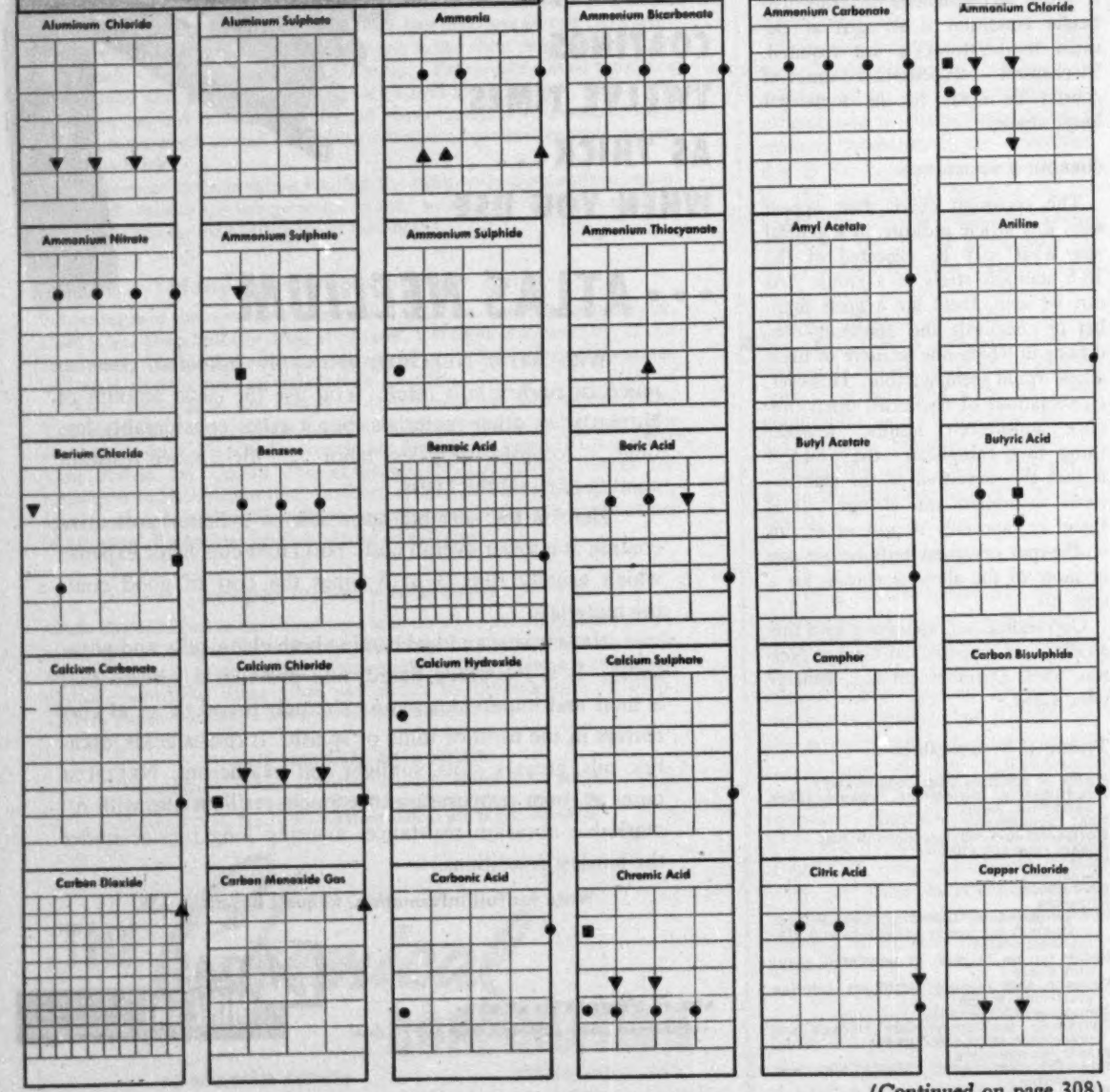
ATLAS PRODUCTS STAND
...between your process and corrosion

ATLAS MINERAL

Corrosion-proof: Cements • Coatings • Vessel Linings • AMPCOFLEX®

Corrosion Resistance of 18-8 Stainless Steels





(Continued on page 308)

Plan your processing for profit —call in

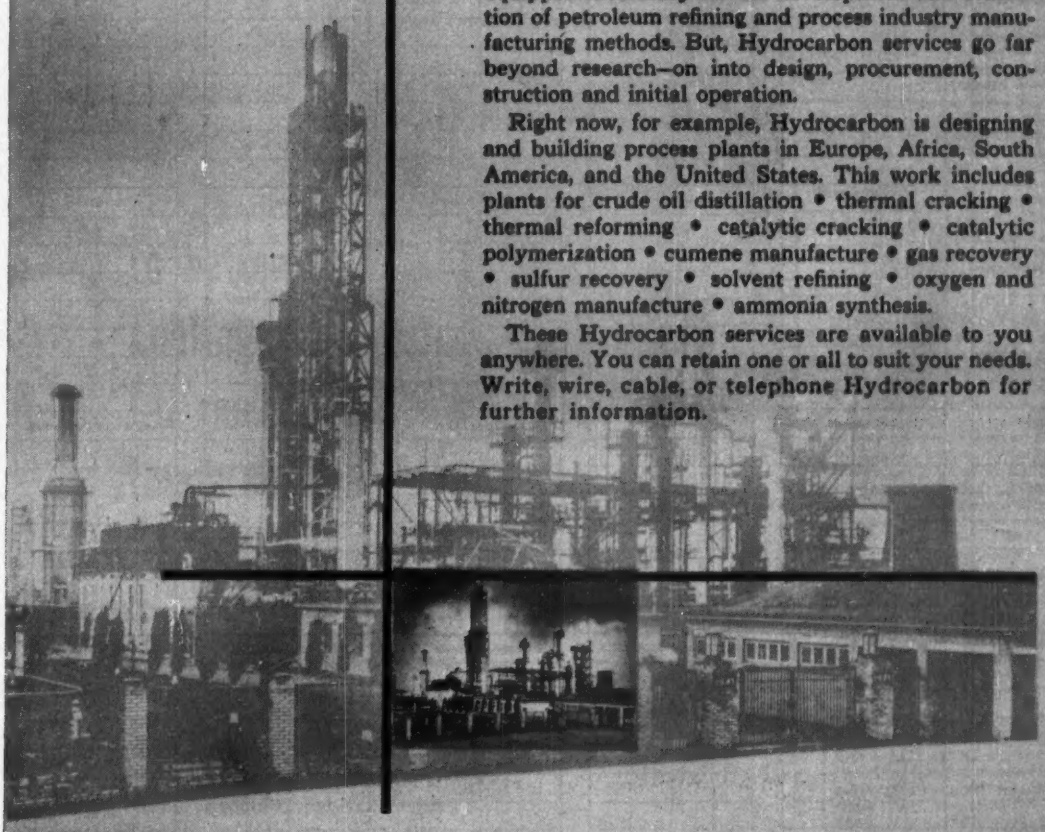
Hydrocarbon

One call, *one contract* with Hydrocarbon Research, Inc. will take your plans from idea to operating reality —efficiently, economically and speedily. Hydrocarbon offers many comprehensive services—in one integrated organization.

Hydrocarbon maintains a fully staffed, completely equipped laboratory for the development and evaluation of petroleum refining and process industry manufacturing methods. But, Hydrocarbon services go far beyond research—on into design, procurement, construction and initial operation.

Right now, for example, Hydrocarbon is designing and building process plants in Europe, Africa, South America, and the United States. This work includes plants for crude oil distillation • thermal cracking • thermal reforming • catalytic cracking • catalytic polymerization • cumene manufacture • gas recovery • sulfur recovery • solvent refining • oxygen and nitrogen manufacture • ammonia synthesis.

These Hydrocarbon services are available to you anywhere. You can retain one or all to suit your needs. Write, wire, cable, or telephone Hydrocarbon for further information.

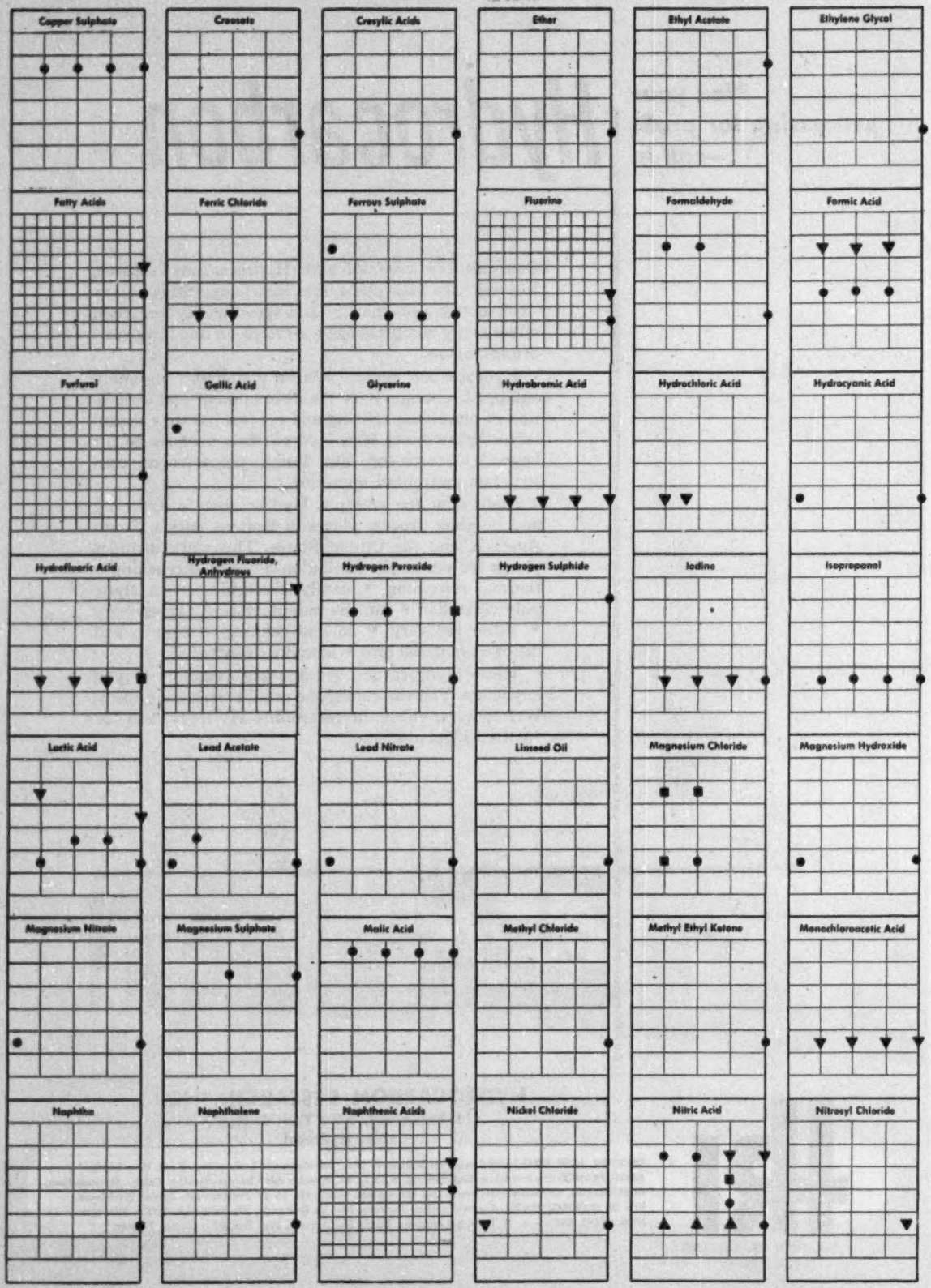


HYDROCARBON RESEARCH, INC.
115 Broadway, New York 6, N. Y.
Cable: Hydrocol

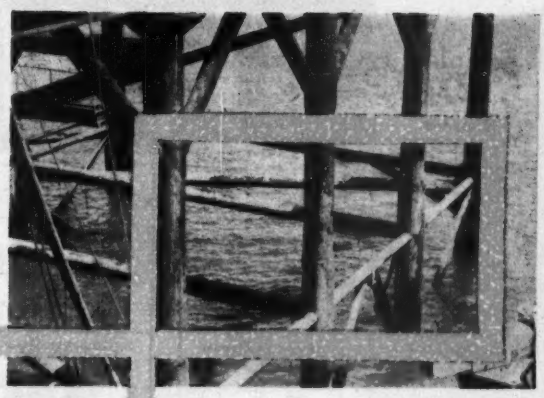
HRI
PLANNED PROCESSING FOR PROFIT

TRENTON, NEW JERSEY—Hydrocarbon Research, Inc., Development Laboratory, P. O. Box 1419.
PARIS, FRANCE—Hydrocarbon Engineering, S.a.r.L. 44, Avenue des Champs-Élysées. Cable: Hydrocarbon.
DUESSELDORF, GERMANY—Hydrocarbon Mineraloel, G.m.b.H., 15-17 Furstenwall. Cable: Hydromin.
RIO DE JANEIRO, BRAZIL—General Heitor Pedroso, Rua da Quitanda, 20, Sala 801. Cable: Bispetro.
NEW DELHI, INDIA—A. R. Palit & Company, Sujan Singh Park, Post Box 671. Cable: Palitar.

Corrosion Resistance of 18-8 Stainless Steels



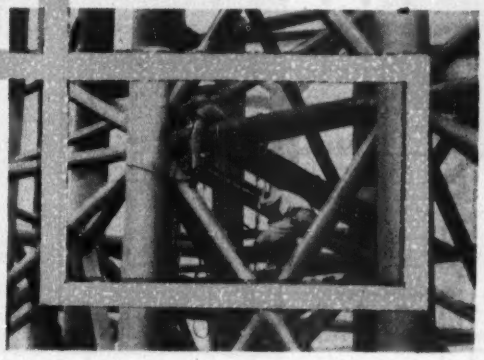
(Continued on page 310)



if this is your trouble...

Here is an off-shore drill structure located in the main pass of the Mississippi River. This installation was painted in June 1948 with three coats of oil-base marine paint. Note the condition, *only one year later!* The coating just couldn't take it!

here is your answer!



to better coatings for really tough service

THE ANSWER?

Coatings based on VINYLITE Brand Resins applied to well structures, as shown in this photograph.

THE RESULTS?

In June 1949, VINYLITE Resin coatings were applied to a 10-well structure located under similar severe service conditions. *Over two and one-half years later,* the corrosion engineer reported all coatings applied on properly treated surfaces were in good condition.

VINYLITE Resin coatings give longer, more trouble-free service . . . for oil refineries, pipe lines, marine equipment, plants and structures . . . wherever surfaces are exposed to rough treatment, chemicals, salt water, weather extremes, industrial gases.

Properly applied, VINYLITE Resin coatings won't crack, chip, peel or fade. They really stay put on metal, concrete, and masonry.

Photos courtesy of Minnesota Mining & Manufacturing Company, Detroit 2, Mich., whose COROGARD coating system, using VINYLITE Resins as base, was used to coat the 10-well installation, and to repaint the structure where oil-base marine paint failed.

BAKELITE TRADE-MARK AND Vinylite BRAND RESINS

TRADE MARK

BAKELITE COMPANY

A Division of
Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.

You can also benefit by these resins and finishes

Polystyrene Latex *— This superior base for economical interior wall finishes provides paints that are completely flat. Yet, they are tough and flexible, resistant to water, abrasion, acids and alkalies, and are 100% washable . . . even scrubbable. They are used on any type of interior wall, ceiling or trim surface with excellent hiding power and coverage. They seal, size and finish all in one coat. They adhere tightly to all surfaces . . . even glass, tile, and enamel, and are very fast drying. Paints based on POLYSTYRENE LATEX have excellent color retention, from whites and pastels to deep tones. They flow smoothly with superior leveling, and are applied by roller or spray as easily as with brush.*

100% Phenolic Resin Finishes — Now available are high-quality varnishes, metal primers and dark-colored topcoats at economical prices, using BR-103, 100% phenolic resin as a base. This resin provides fast-drying, good pigment stability and color fastness, and excellent durability. Used as low-cost primer-surfacers, gloss primers, or sanding primers for metal structures and products, coatings based on BR-103 bake quickly, and have good dip-tank stability. They are reducible with mineral spirits and do not skin.

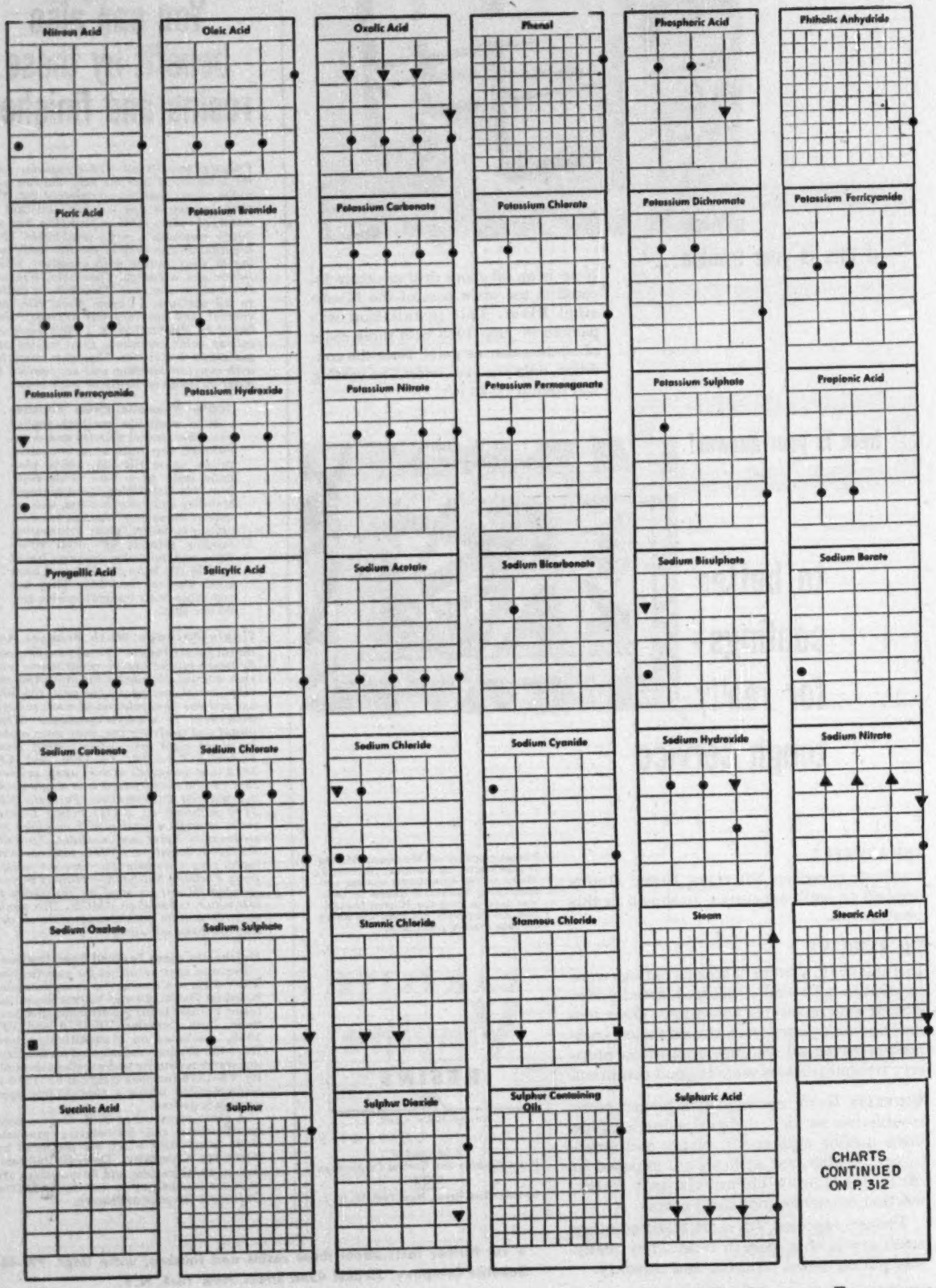
Single-Package Wash Primers and Metal Conditioners *— Three new formulas for wash-primer metal conditioners provide unique advantages for industrial and other metal coating. In the past, the diluent and the base solution of wash primers were kept in separate packages. When mixed and ready for use, they were usable for about eight hours after mixing. Now, Formulas XE-5298, XE-5300, and XE-5368 are pre-aged, stable wash primers that can be ready-mixed in a single package without deterioration. Formula XE-5298 is based on XYHL, vinyl butyral resin, strongly adhesive with excellent resistance to water and sunlight. Formula XE-5300, based on XYHL, also contains basic zinc chromate for severest conditions. Formula XE-5368, especially recommended for use on steel for resistance to salt water, is based on VMCH. This vinyl-chloride-acetate resin also provides air-dry and low-bake adhesion.*

Finishes to meet Federal Specifications — Two new spar varnishes for specification TT-V-121c are among the many formulas based on BAKELITE and VINYLITE coating resins to meet latest government specifications. Both formulas, VF-1576 and VF-1586, are based on competitively-priced BR-9400 phenolic resin, noted for fast drying, water resistance and excellent durability. VF-1576 includes tung oil, VF-1586 is recommended where a tung-oil-free spar varnish is desired.

A great many other U. S. Government specifications call for coating products made from resins which are produced by BAKELITE COMPANY. Detailed information on specifications and formulations are kept continuously up-to-date by BAKELITE COMPANY for your assistance.

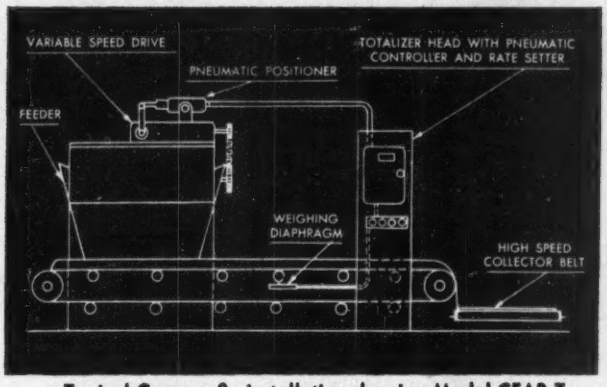
• **For further facts about these resins and finishes, write Dept. PW-46, Bakelite Company, 30 East 42nd Street, New York, N.Y.**

Corrosion Resistance of 18-8 Stainless Steels, cont . . .



WEIGH IT ...on the Go!





Typical Conveyoflo installation showing Model CFAB-T Conveyoflo Meter controlling flow of tobacco in automatic blending process. Conveyoflo employs pneumatic controller to automatically control feeder output within very narrow tolerances.

Conveyoflo Meters are serving in many other process industries: food, soap, fertilizer, pharmaceutical, steel, paper, glass, heavy chemicals, mining, power. What's *your processing problem?*

Weigh it with BUILDERS CONVEYOFLO . . . the modern meter for *continuous, accurate weighing* of bulk material passing over conveyor belts. This precision meter can be equipped with a Controller to maintain any desired preset rate of delivery from the conveyor in which it is installed. Or it can be used to pace auxiliary feeders in automatic processing systems. Conveyoflo is furnished as a separate, self-contained unit— or for installation in your present conveyor lines.

CONVEYOFLO FEATURES

- ACCURATE . . . within ±½ of 1% of actual weight from maximum to 50% of rated capacity; within 1% from 50% to 25% rate; within 2% from 25% to 10% of meter's rated capacity.
- COMPACT . . . weight sensing mechanism completely contained within conveyor structure. No overhead levers. Panel stand only 9" x 18" — may be any height.
- AUTOMATIC TOTALIZER COMPENSATION for variations in belt speed and changes in belt weight.
- RESPONDS ACCURATELY to rapid load variations.
- PACES AUXILIARY EQUIPMENT (feeders, controllers, continuous blending processes, etc.) and operates secondary totalizers, indicators, recorders.

BUILDERS

BIF INDUSTRIES (DIVISION OF B-I-F INDUSTRIES) BUILDERS

SEND COUPON FOR DETAILS

BUILDERS-PROVIDENCE, INC.
369 Harris Ave., Providence 1, R. I.

Please send Bulletin 550-H4 describing Builders Conveyoflo Meter.

Name.....

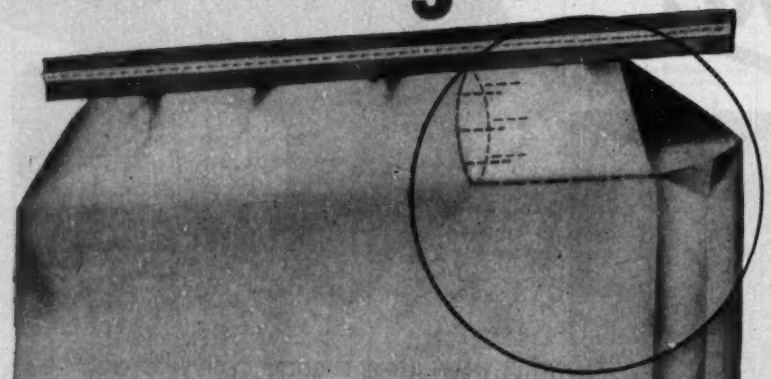
Company.....

Street.....

City.....State.....

The newest, best multiwall bags for valve-packing your fertilizer . . .

Bemis B-FLEX Valve Bags!



You should switch to Bemis B-FLEX promptly because of . . .

1. LOWER BAG COSTS. You'll save up to $4 per thousand compared with conventional inner-sleeve valve bags.

2. LOWER PRODUCTION COSTS. Faster handling on your packing machines.

3. FASTER PACKING. Are jam-ups a problem? Not with Bemis B-FLEX. No flapping inner-sleeve to slow down material flow.

4. UNIFORM WEIGHTS. You can hit your weights "right on the button." Stop over-packing.

5. CLEAN PACKAGE. Minimum sifting.

6. BETTER CUSTOMER SATISFACTION. No loose, torn sleeves.

And, of course, you get the added benefit of Bemis' crisp, bright, multi-color printing—the finest printing your brand can have on multiwall bags.

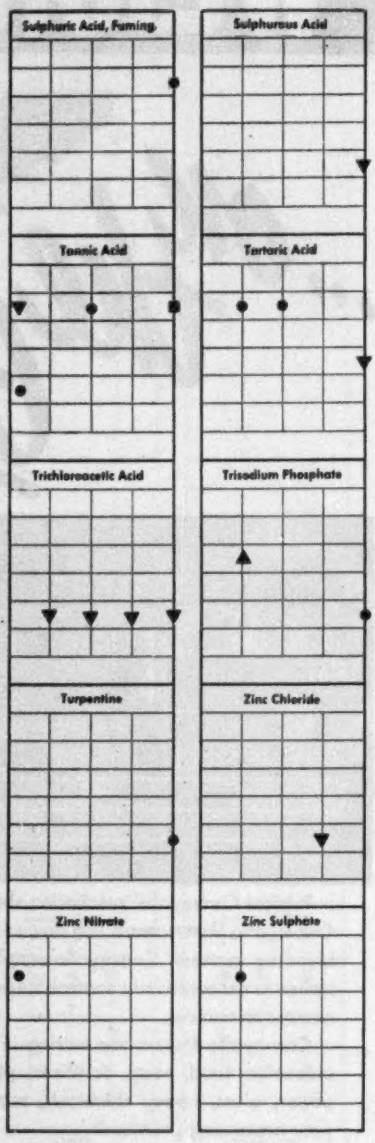
Ask your Bemis Man for the complete B-FLEX story.

Bemis

General Offices: St. Louis, Mo.

CORROSION FORUM, cont. . .

18-8 STAINLESS STEELS
(Key on p. 306)



Notice . . .

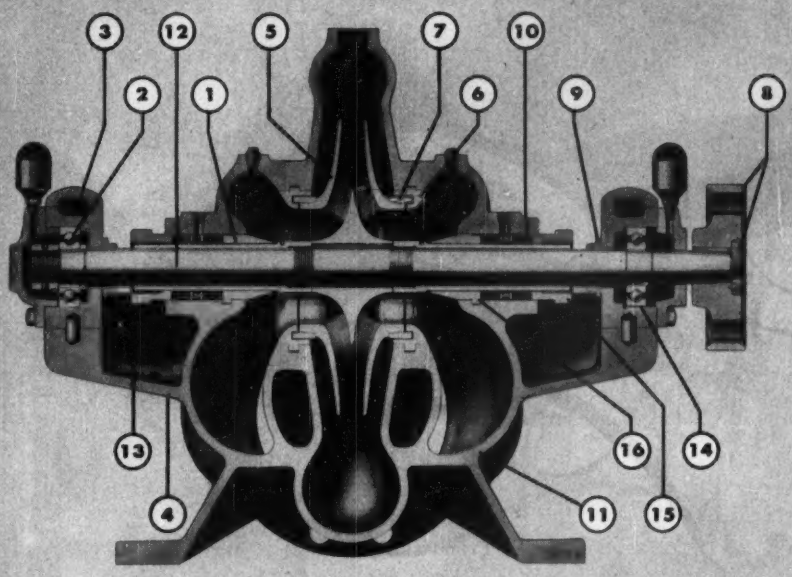
This is the eighteenth in a series.

Already Published:

Furane Cements, Dec. 1951
Phenolic Cements, Jan. 1952
Sulphur Cements, Feb. 1952
Silicate Cements, March 1952
Tantalum, April 1952
Aluminum, May 1952
Hastelloy C, June 1952
Hastelloy B, July 1952
Hastelloy D, Aug. 1952
Carbon & Graphite, Sept. 1952
Polyethylene, Oct. 1952
Polyvinyl Chloride, Nov. 1952
Reinforced Polyesters, Dec. 1952
Styrene Copolymers, Jan. 1953
Lead, Feb. 1953
Glassed Steel, March 1953

DE LAVAL
SINGLE STAGE CENTRIFUGAL PUMPS

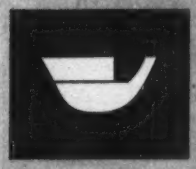
for dependable industrial service



Labyrinth wearing rings minimize leakage...maintain high efficiencies



Labyrinth rings used in these De Laval pumps retard flow of water through labyrinth passage.



Flat rings showing relatively unimpeded flow of water.

(1) **Shaft Sleeves** are screwed on, to abut the impeller and make a water-tight joint. Sleeve expands freely and independently of shaft when temperatures change. There is no tendency to buckle.

(2) **Thrust Bearing** locates rotor axially.

(3) **Bearing Caps** easily removable for maintenance.

(4) **Bearing Brackets** scraped to lining bars for perfect alignment.

(5) **Impeller** hydraulically balanced, finished on all surfaces.

(6) **Labyrinth Wearing Rings** held accurately in machined grooves in both case and cover.

(7) **Impeller Wearing Rings** threaded on impeller, opposite to rotation.

(8) **Flexible Coupling** ground on all exposed surfaces and statically balanced, complete coupling supplied, pump half mounted on taper so that it can be easily removed. Check nut locks coupling on taper.

(9) **Deflector** keeps water out of bearing.

(10) **Stuffing Boxes** extra deep; lantern rings for water sealing.

(11) **Pump Case** horizontally split, machined to limit gages.

(12) **Steel Shaft** ground to limit gages.

(13) **Drip Boxes** large, provided with drain openings.

(14) **Radial Bearing** free to move axially, thus avoiding temperature strains.

(15) **Glands** split horizontally.

(16) **Protecting Bushings** renewable.

You can count on the performance of the De Laval Single Stage Centrifugal Pumps because they are precision-made to high manufacturing standards and incorporate the many quality design features shown in the cross-section.

They operate at high or low speeds, at high or low heads...with maximum efficiency.

For example, De Laval G, I and K Single Stage Double Suction Pumps have a capacity range of 175 gpm to 6,000 gpm, and heads to 300 feet. They are available in sizes ranging from 4" suction and 3" discharge to 14" suction and 12" discharge. Write for Bulletin 1002.

DeLaval also furnishes larger centrifugals for capacities up to 70,000 gpm. Bulletin 83-29R sent on request.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

DL 198



WHAT WILL YOU FIND *inside your process lines?*

YOUR process lines will stay *clean, smooth* and *bright inside*... as free-flowing as the day they were installed, if they're Chase Copper Water Tube.

Chase Copper Water Tube and Chase Wrought Solder-Joint Fittings make a line that's corrosion resistant, pressure-tight, leak-proof. It *can't* clog with rust. They're an ideal team for liquids, process gases, and refrigeration.

So make sure *you* specify Chase Copper Water Tube and Chase Wrought Solder-Joint Fittings. They'll pay off in lower maintenance and replacement costs.

Chase BRASS & COPPER

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• *The Nation's Headquarters for Brass & Copper*

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Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

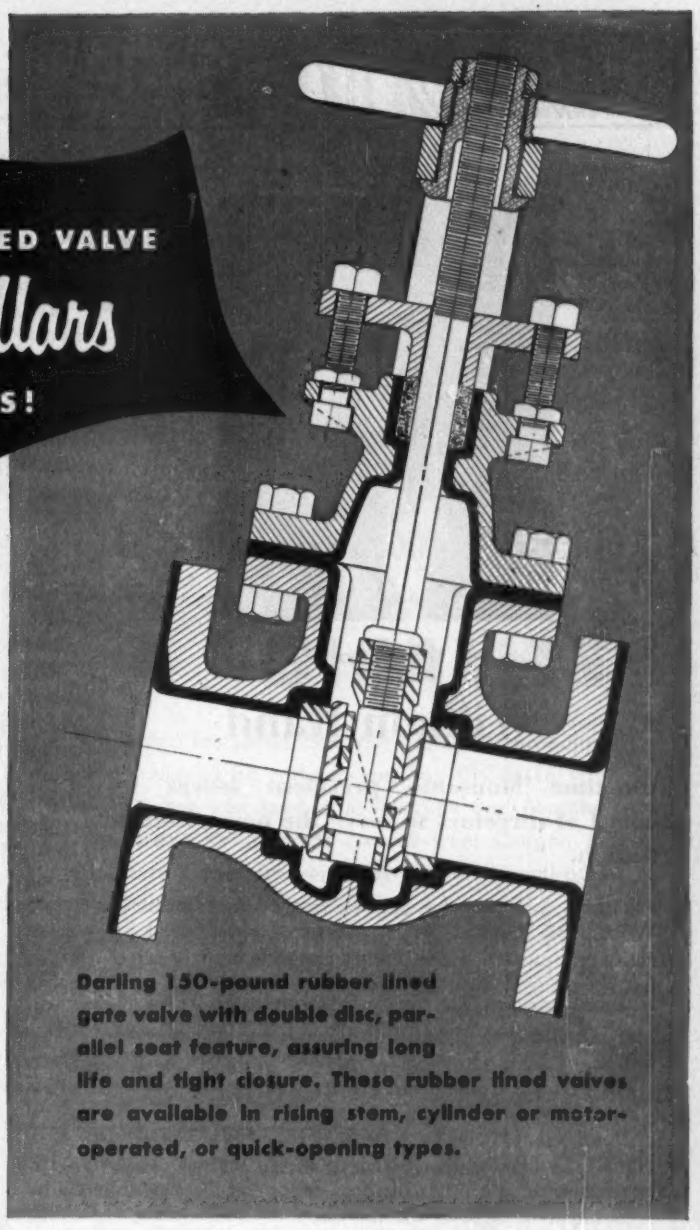
HOW THIS RUBBER LINED VALVE

stretches dollars

IN CORROSIVE SERVICES!



it's a DARLING fully revolving double disc iron body gate valve



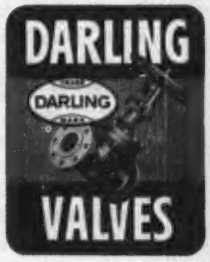
Darling 150-pound rubber lined gate valve with double disc, parallel seat feature, assuring long life and tight closure. These rubber lined valves are available in rising stem, cylinder or motor-operated, or quick-opening types.

IN many corrosive services up to 180° F, Darling hard rubber lined iron body gate valves are taking the place of costly special alloy valves . . . saving plenty of dollars!

And when it comes to year-in, year-out behavior, they can't be beat! A proved bonding technique permanently prevents separation of the hard rubber lining from the valve body. All interior working parts are made of alloys suitable for the corrosive conditions involved.

Equally important, these valves feature Darling's fully revolving double disc parallel seat principle. This, combined with the equalizing wedges, means easy, *tight* closure even if seats are not parallel due to line stresses. It means *uniform* distribution of wear for prolonged life with minimum maintenance cost.

SEND FOR DATA. A bulletin covering Darling rubber lined *gate* and *check* valves is yours for the asking. In addition, Darling parallel seat revolving disc gate valves are available in a wide range of sizes and constructions for all kinds of normal and unusual service, and for pressures up to 1500 pounds. We'll gladly furnish specific recommendations on the proper valves for your particular service.



DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

Names in the News Edited by Frances Arne



Man of the Month:

William Rand

One-time Monsanto president leaves its board of directors to serve the new administration.

The U. S. Senate has just confirmed appointment of William M. Rand as deputy director of the Mutual Security Administration. Mr. Rand's imposing business career has been largely spent at Monsanto Chemical Co. He was its president from 1945 to 1951. Since then he has been a member of its board of directors and finance committee.

His new MSA post is not his first venture into government affairs. For instance, in the fall of 1945 he was named as one of management's 18 principal representatives for the president's labor-management conference in Washington.

Mr. Rand was born in Watertown, Mass. He graduated from Phillips Exeter Academy in 1905 and later from Harvard.

In 1908 he participated in the Olympic Games at London and in his senior year captained Harvard's track team which won the intercollegiate championship of the United States. It was his athletic interests which prompted the choice of his first job with the Mutual National Bank of Boston. In addition to the job, the employer offered young Rand a place in the crew of his Sonder boat which would compete for the American team in the annual races with the Germans for the Kaiser's cup. The boat didn't win but Mr. Rand has kept up his interest in salt water sailing to this day.

Following World War I, he went to work for the Russell Co. which managed the Merrimac Co., an old and well-established New England firm engaged in the manufacture of heavy chemicals. He became Merrimac's treasurer in 1920 and shortly was made vice president in charge of sales.

Monsanto bought the Merrimac's stock in 1929. In 1933, Mr. Rand became a member of the Monsanto board of directors and in 1935 he was made executive vice president of Merrimac, then operated as a Monsanto subsidiary. Soon after he became Merrimac's president serving in that capacity until 1937 when Merrimac was liquidated to become Monsanto's Merrimac Division.

With the change, Mr. Rand became vice president of Monsanto and general manager of the Merrimac Division, posts which he held until his elevation to the presidency.

Harold M. Patterson. Manager of engineering for the plastics department of General Electric Co.'s chemical division. Has been associated with G-E plastics engineering activities for 24 years, most recently as an application engineer for the plastics department.

A. Ludlow Clayden. Technical associate, Sun Oil Co.'s chemical research and development department. Has been a Sun engineer for 30 years. His successor as manager of the company's automotive laboratory; **John G. Moxey, Jr.**, who has been his assistant.

Allen Abrams. Cited for his accomplishments at the annual University of Wisconsin Engineers' Day celebration in April. Vice President of the Marathon Corp., Rothschild, Wis. Joined the company in 1926 as its technical director. Studied at Washington and Jefferson College and MIT.

Sidney P. Thomes. Chemical engineer to the Monsanto Chemical Co.-Union Electric Co. of Missouri atomic electric project. On leave of absence from Monsanto since September 1951 as a member of the Westinghouse Electric Co.'s atomic powder division at Pittsburgh, Pa. Graduate of Iowa State College.

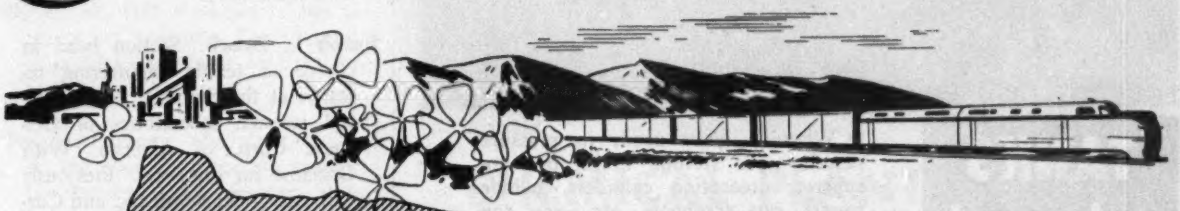
Earl H. Bradley. President of Builders Iron Foundry, Providence, R. I. Has been executive vice president since 1949. Joined the company in 1934. Previously a partner in the Miner-Bradley Mfg. Co. and also an experimental engineer with Brown & Sharpe Mfg. Co.

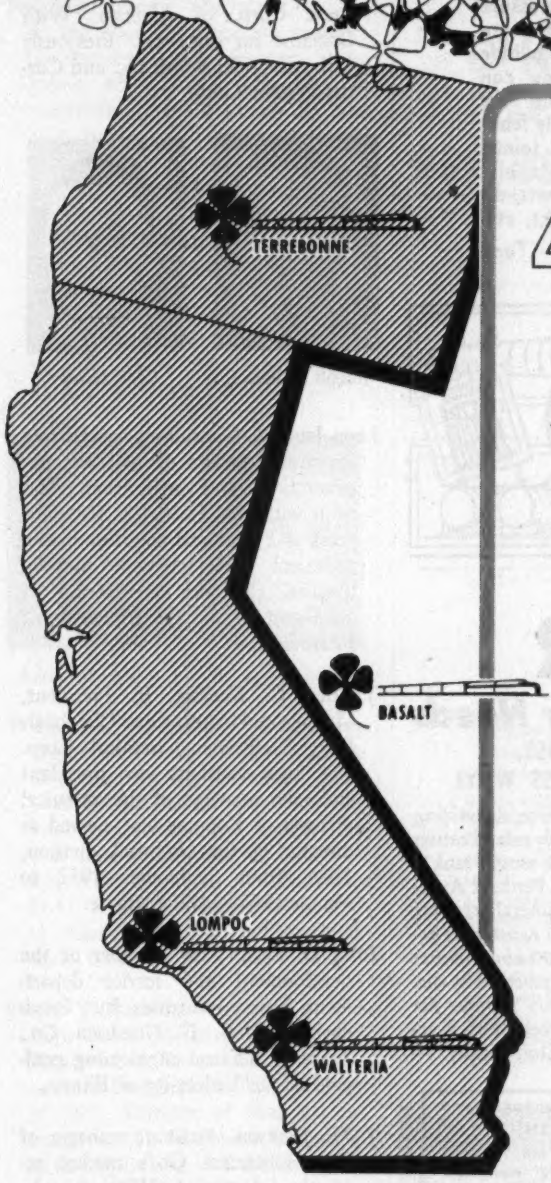
Richard E. Dunning. From production superintendent to plant manager, Logo, Inc., Chicago, came to Logo in 1951 from the Bjorksten Research Laboratories. Chemical engineering graduate of the University of Wisconsin.

Lloyd L. Auston. Director of American Potash & Chemical Corp. Formerly a company vice president.

Gustav Egloff. Recipient of the Washington Award, founded in 1916 by John Watson Alvord and

In this case, 4 IS THE LUCKY NUMBER





4 Plants Served by 4 Different Railroad Systems

ASSURE AN UNFAILING SUPPLY OF

DICALITE

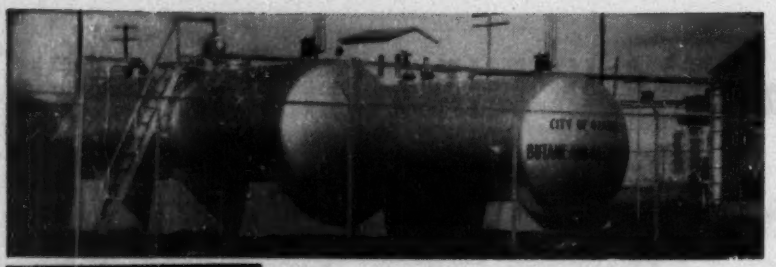
These two foursomes are your best guarantee that you'll *always* be able to get the DICALITE you want, when you need it, in the type and quantity you order. With plants spread from Oregon to Southern California, with four different railroad systems to supply you, no local occurrence can shut off the DICALITE supply. If fire, flood, storm, power failure or mechanical troubles beset one locality, the other three can, and will, supply you —an important point, considering the recent difficult supply situation.

Further insurance that you'll get quick, dependable delivery is our increased production capacity —today 75% greater than it was a year ago. Whether you need filteraids, fillers, insulation or other diatomaceous materials, DICALITE provides products that meet high performance and quality standards... and provides them in full supply.

Any information you may need, any expert technical assistance you might require, will be cheerfully furnished. Write your nearest DICALITE office.

Dependable GREAT LAKES *Dicalite* DIATOMACEOUS MATERIALS

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION • NEW YORK 17 • CHICAGO 1 • LOS ANGELES 17



TANKS and vessels that are CORRECT in design

● Whatever your needs in pressure vessels—gas storage tanks, pressure spheres, creosoting cylinders, bubble towers, gas scrubbers, etc.—you can depend on Cole for tanks that are correct in design and permanently leak-proof at the welded or riveted joints.

We also design and fabricate elevated tanks, acid tanks, dye vats, digestors, standpipes, storage tanks, etc.

Write for latest Cole catalog—*"Tank Talk."*

Established 1854

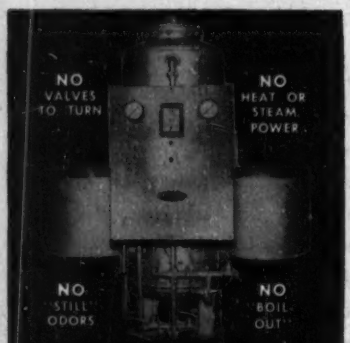
R. D. COLE MFG. CO.

NEWNAN, GEORGIA

ELEVATED TANKS • VESSELS • CYLINDERS
TOWERS • BINS • STANDPIPES

HIGH PURITY WATER

For Process, Boiler Feed & Other Needs



The new Penfield Mono-Column Demineralizer pictured above performs all its operating functions automatically — even accomplishes complete regeneration, including automatically recutting in effluent, with one turn of a switch. Write for full information on units of any desired capacity from 10 to 10,000 gph.

THE LOW COST, NO MUSS, NO FUSS WAY!

Employing the most effective deionizing technique known (intimately mixed cation and anion exchangers in a single tank)†, raw water passes through a Penfield Automatic Mono-Column Demineralizer only once — *yet comes out with resistances reported as high as 20,000,000 ohms.* Better mineral-free purity than is practical by distillation is supplied for *only pennies per each 1,000 gallons.* And everything is accomplished completely automatically — *without muss or fuss.*

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FILTERS SOFTENERS Penfield "Planned Purity" PAYS! DEGASIFIERS DEMINERALIZERS

administered by the Western Society of Engineers. Director of research, Universal Oil Products Co., since 1917.

Joseph L. Barach. Section head in charge of textile engineering research at the Summit, N. J., central research laboratories of Celanese Corp. of America. With Celanese for one year. Previously with Alexander Smith Inc. and Curtiss-Wright Corp.



Joseph L. Barach



Leon Jacolev

Leon Jacolev. Consultant specializing in various phases of synthesis gas generation and utilization. Has been with the Texas Co. for eight years as a chemical engineer in the technical and research division. Studied chemical engineering at Northeastern and the University of Pittsburgh.

Thomas C. Keeling, Jr. President, Mathieson Hydrocarbon Chemicals Div., Mathieson Chemical Corp. Has been assistant vice president and sales manager of the chemical division of Koppers Co. Served as director of the chemical division, NPA, from September 1952 to March 1953. MIT graduate.

John D. Farr. New member of the development and service department, Emery Industries, Inc. Previously with B. F. Goodrich Co., Akron. Chemical engineering graduate of the University of Illinois.

J. W. Everson. Assistant manager of Dow Chemical Co.'s market research department. With the department since 1950. Joined the company's plastics technical service in 1946. Studied at Wooster College, Ohio, MIT and Harvard.

Charles H. Groff. Technical director, Watson-Standard Co. Has been technical director of Surface Chem-

icals, Inc. From 1943 to 1946, assistant technical director, Watson-Standard. Studied at Temple University.

Robert W. Pelz. Assistant to the director of research, Ferro Corp., Cleveland. Graduate of the University of Illinois.

Julian M. Avery. Technical adviser to the planning group on product development and research programs, Ethyl Corp. Has been a consultant to the company for the past two years. From 1941 to 1946, vice president and director of research and development, Diamond Alkali Co. From 1936 to 1941, engineering consultant and New York representative, Arthur D. Little, Inc. For 17 years previous to that he spent mostly in Europe on various assignments for Union Carbide and Carbon Corp. Studied at MIT.



Julian M. Avery



W. J. McCarthy

William J. McCarthy. Development engineer, Hycar rubber section, sales development laboratory, B. F. Goodrich Chemical Co. Prior to joining Goodrich he served for over nine years with the Office of Synthetic Rubber, Washington, D. C. as a field representative and as chief of the finished products unit. Graduate of Trinity College.

Glenn T. Seaborg. Recipient of the John Scott Medal Award of the Board of City Trusts of Philadelphia awarded by the Philadelphia section of ACS. Director of chemical research at the radiation laboratory of the University of California. Co-winner of the Nobel prize in chemistry in 1951 for his discoveries in the chemistry of the transuranium elements.

Dorothy M. Bryant and **Jerome Linder.** Chemists, development and research department, Hooker Electrochemical Co. Miss Bryant

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DUST CONTROL

A SINGLE UNIT OR A COMPLETE SYSTEM

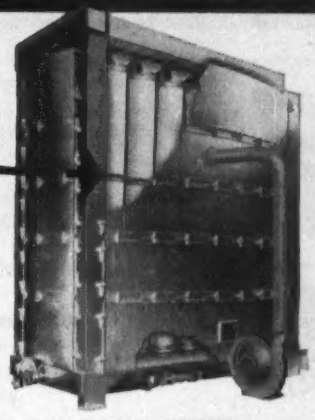
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DAY's reverse air jet mechanism provides uniform cleaning over the entire length of the tubes.

Reverse Air Jet Ring Travels Continuously Up and Down The Entire Filter Tube. High Pressure Reverse Air Blown Through The Filter Felt Keeps Filter Tubes Clean Constantly.



99.99+% Filtering Efficiency Provides Important Savings In Reclaiming Valuable Products

DAY's improved cleaning action permits the use of a better grade wool filtering fabric which gives filtering efficiencies up to 99.99+%. This better filter cloth also allows higher air-to-cloth ratios with uniform back pressure. Plant space is saved because less filter is needed to handle equal volumes of air, and one DAY "AC" Dust Filter can handle four different product streams simultaneously, without mixing. It will pay you to investigate the DAY "AC" Dust Filter for your dust control program.

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NAMES IN THE NEWS, cont. . .

has worked as an analytical chemist for G. Roger Wood in Vancouver, B.C. and as a control chemist for the Dept. of National Defense in Niagara Falls, Ont. Mr. Linder studied chemistry in City College of New York, Brooklyn College and Polytechnic Institute of Brooklyn.

Kenneth W. Richardson, Jr. Assistant director of development in charge of organic development projects at the Barberton, Ohio, plant of Columbia-Southern Chemical Corp. Previously, development supervisor in charge of pilot plants at Barberton. Joined the company in 1946. Northeastern graduate.

E. R. Durrer. President of the Givaudan Corp. and its affiliate companies, Givaudan-Delawanna, Givaudan Flavors Inc., Sindar Corp. and Givaudan-Foreign, Inc. Has been executive vice president since 1947.

Arnold O. Beckman. Appointed to the board of trustees of the California Institute of Technology, Pasadena. President and founder of Beckman Instruments, Inc.

Nathaniel Willis. Manager of quality control, Logo, Inc., Chicago. Came to the company in 1951 from the Argonne National Laboratories. Studied at Penn State and Illinois Institute of Technology.

Paul Logue. Chairman of the Manufacturing Chemists' Assn.'s committee on chemicals in foods. Associated with Monsanto Chemical Co. New members appointed to this committee: **Harry A. Kuhn,** Allied Chemical & Dye Corp.; **Paul D. V. Manning,** International Minerals & Chemical Corp.; **Rothe Weigel,** Victor Chemical Works; **Ernest W. Reid,** Corn Products Refining Co.

Ronald Barraclough. Assistant manager of the Petrolia, Pa., plant of the chemical division of Koppers Co. Has been manager of the company's Seaboard chemical plant since 1947. Joined Koppers in 1941 as a research cadet at the Kearney, N. J., plant. Studied at Pennsylvania State College. New manager

hydrofluoric acid

caustic potash

sulfuric acid (66 baume)

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sulphur chloride

dimethyl sulfate

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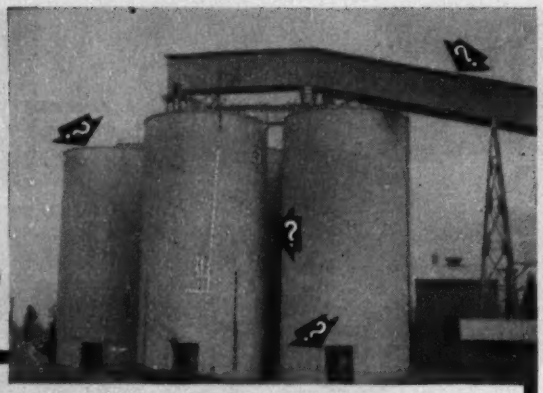
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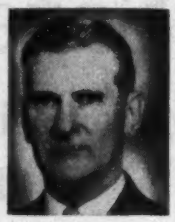
YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.



of the company's Kearney plant: **G. K. McDonald** who has been general foreman at the Seaboard plant since 1947. Joined the company in 1946. Graduate of Westminister College.

Gene M. Wild. Biochemist, antibiotics manufacturing and development division, Eli Lilly and Co. Doctorate from Iowa State College.

Jackson V. Vernon. Vice president of Food Machinery & Chemical Corp., San Jose, Calif. He is head of the corporation's Niagara Chemical Div. and has been associated with it since 1923.



J. V. Vernon



G. E. Temple

George E. Temple. Vice president and general manager of Catalytic Construction of Canada, Ltd., with headquarters at Sarnia, Ont. Previously with the Anglo-Iranian Oil Co. for 16 years, most recently as assistant works manager at Abadan.

Harold M. Coleman and **Morgan W. Rider.** Assistant supervisors, chemistry and chemical engineering department, Armour Research Foundation. Mr. Coleman was formerly a research scientist at Armour and Co., Chicago; Mr. Rider was chemist in charge of research for the U. S. Rubber Co. in Penang, Malay. New research chemical engineer for the foundation: **Frank Lerman,** Formerly director of bio engineering for the VioBin Corp., Monticello, Ill.

Charles Leet. Manager of the Bayonne, N. J., refinery of Esso's manufacturing department. Has been assistant general manager of the company's Baton Rouge refinery since 1950. Came to the Baton Rouge refinery in 1931 as chemical engineer. New assistant general manager at Baton Rouge: **J. P. Warner** who has been general superin-

tendent. New general superintendent: **F. A. L. Holloway,** formerly head of the technical division. His successor: **G. R. Murrell,** former head of the petroleum products division.

Davis E. Buchels, Jr. From technical assistant in the soda ash section to supervisor of the caustic section at the Baton Rouge plant of Solvay Process Div., Allied Chemical & Dye Corp. Joined the company in 1948. Chemical engineering graduate of Louisiana State University.

John D. Roberts. From associate professor of organic chemistry at MIT to professor of organic chemistry at California Institute of Technology.

James B. Auston. Chairman of the committee on chemical warfare, Dept of Defense research and development board. Director of research and chief of United States Steel Co.'s research laboratory at Kearny, N. J.

Walter G. McBurney. Technical director at the Niagara Falls, Ont., plant of North American Cyanamid Ltd. Since joining the company in 1924 he has done research for Cyanamid in several European countries, studying and evaluating various process and manufacturing methods. Plant manager at the Niagara Falls plant: **Thomas P. Turchan.** He was works manager of the Niagara Falls, New York division of Stauffer Chemical Co. before coming to Cyanamid in 1952.

John M. High. Sales manager, insulation division, Mundet Cork Corp., North Bergen, N. J. Has been with the Ruberoid Co. since 1934. Chemical engineering graduate of the University of Pennsylvania.

William L. Garbrecht. Organic chemist in the organic chemical development department, Eli Lilly and Co., Indianapolis. Doctorate in organic chemistry from Michigan State.

Donald D. MacFarlane. President of Michigan Chemical Corp. Continues as chairman of the board.

Jasper P. Scott. Executive director of operations planning, Eli Lilly and Co. Previous Lilly jobs: research chemist, assistant director of research development, director of

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DYNEL industrial clothing has outworn that of other fibers in the same service by as much as 10 to 1. DYNEL'S inherent chemical resistance ... good strength—wet or dry ... high abrasion resistance assure extremely long laundry life.



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Acids	Conc.	Temp.	Appearance	Loss in Strength Warp	Loss in Strength Filling
Sulfuric	70%	50° C	No effect	8.8%	3.4%
Hydrochloric	38%	50° C	No effect	None	None
Hydrofluoric	50%	Room	No effect	3.4%	2.0%
Nitric	40%	50° C	No effect	None	None
Bases					
Sodium Hydroxide	50%	50° C	No effect	4.5%	6.6%
Ammonium Hydroxide	28%	Room	No effect	None	None
Oxidizing Agents					
Hydrogen Peroxide	30%	Room	Slight bleaching	None	None
Sodium Hypochlorite	Commercial	50° C	No effect	None	None
Solvents					
Ethyl Alcohol	100%	50° C	No effect	None	None
Perchlorethylene	100%	50° C	No effect	None	None
Deodorized Kerosene	100%	50° C	No effect	None	None
Toluene	100%	50° C	Slight bleaching	3.4%	4.4%

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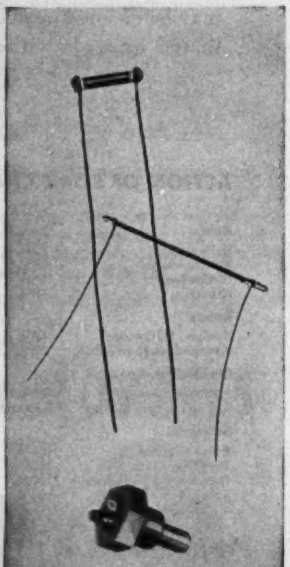
Whether you use these temperature responsive resistors in standard or special models, you can be sure of this. *They'll match your needs* for resistance values, size, temperature coefficient, mountings and quality. Made in our own plant under carefully controlled conditions, Bendix-Friez Thermistors know no equal.

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.140 x .75	45.0 ohms	86 ohms	194 ohms
.040 x 1.5	12,250 ohms	26,200 ohms	65,340 ohms
.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

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Used in this typical application for sensing the temperature of hydraulic oil.

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NAMES IN THE NEWS, *cont. . .*

scientific contacts, director of the functional coordination division. Joined the company in 1920.

E. V. Watts. Assistant director of production, General Petroleum Corp. New manager of field operations: **B. H. Robinson.**

Judson G. Brown. Chemical engineer for Virginia-Carolina Chemical Corp., Richmond, Va. Previously, section leader in charge of AEC project for International Minerals and Chemical Corp. Chemical engineering graduate of the University of Michigan.



Judson G. Brown



Kenneth Klipstein

Kenneth H. Klipstein. The 1953 medalist for the annual award conferred by CCDA for outstanding accomplishment in commercial chemical development. Assistant general manager and head of the technical department of the Calco Chemical Div. of American Cyanamid, Bound Brook, N. J. With Calco since 1933.

Francis T. Letchfield. New member of the board of directors, Oliver United Filters Inc., San Francisco. Consulting engineer and assistant vice president of Wells Fargo Bank & Union Trust Co. with which he has been associated since 1926. Graduate of the University of Michigan.

Wilbur E. Kelley. Vice president in charge of engineering, Catalytic Construction Co. Has been manager of the New York operations office of the AEC since 1947. Doctorate from the University of Louisville.

R. W. Faulk. Superintendent of the Norco Refinery, Shell Oil Co. Since 1951, manager of the manufacturing department for Shell Oil Co. of Canada. Began his career with Shell

Reports from Users

Showing Typical Results on Corrosion-Control Problems where *Carpenter* STAINLESS No. 20 is used

Corrodent PRIMARY CONSTITUENT	REMARKS	PROCESS	RATING
Aluminum sulfate plus alumina	245°F.	Mfg. of aluminum sulfate.	Excellent, no sign of pitting after 35 working days.
Concentrated chlorine solution	— —	— —	Type 304 pitted. No. 20 satisfactory.
Fluoborate Plating Solutions	— —	Electroplating copper, zinc, etc.	Recommended for use in any of the commercial fluoborate plating solutions.
Maleic acid	30% concentration	— —	Excellent (better than Type 316).
Phosphoric acid	70% phosphoric 5% sulfuric some hydrofluoric boiling acid at 135°C.	— —	Excellent. Corrosion rate obtained: .0180 IPY.
Sulfuric acid	15/50% H_2SO_4 at room temperature	Nozzle for filling storage batteries.	Excellent.
Sulfuric acid	2 to 3% H_2SO_4 room temperature to boiling	Pickling tank.	Under severe working conditions Carpenter Stainless No. 20 showed no appreciable loss of weight due to corrosion (.00012 IPY).
Sulfuric acid	93% H_2SO_4 saturated with sulfur dioxide	— —	Excellent. Negligible corrosion rate (.00006 IPY).
Sulfuric acid	1% to 105% H_2SO_4	Die manufacturing. Heat exchanger coils.	Approx. 8 times as resistant as lead. Expected equipment life 4 years with Stainless No. 20.
Sulfuric acid	10% solution 140/160°F.	Acid dip pickling process.	Excellent.
Wet Chlorine Gas	— —	— —	Not recommended.
Zinc Phosphate	Solution contained approx. 5% sodium chloride at 180°F.	— —	Estimated life 10 to 30 times that of Type 302 or 304. Total exposure during test: 460 hours.



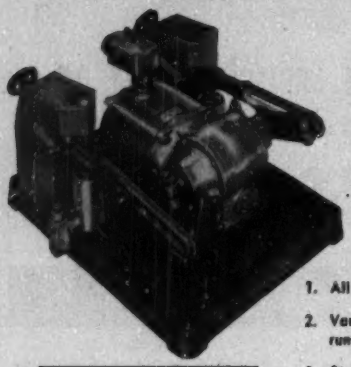
While the production of Stainless No. 20 is controlled by Government Regulations, you may be able to obtain N.P.A. approval of its use, depending on the nature of your job. Meantime, write on your Company letterhead for the No. 20 booklet. THE CARPENTER STEEL CO., 127 W. Bern St., Reading, Pa.

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WRITE FOR BULLETIN 4061-D

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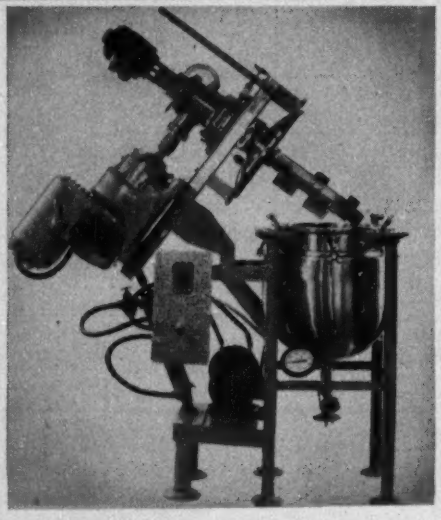
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NAMES IN THE NEWS, *cont. . .*

at the Houston refinery in 1929. Chemical engineering graduate of Southwestern Louisiana Institute.

Paul W. Atwood. President of Union Bay State Chemical Co., Cambridge, Mass. Formerly vice president and director of Stewart Dougall and Associates Inc., management consultants in New York. New director of new product development: **Roland D. Earle.**

William Doering. Recipient of the ACS award in pure chemistry. Professor of chemistry at Yale who helped to synthesize quinine.

Charles E. Wilson. Chairman of the executive committee of the board of directors of W. R. Grace & Co. Became associated with Grace as a director and consultant early in 1952. Had been with General Electric for 51 years working his way from office boy to president.

Hugh W. Gray. Laboratory director, textile fibers department's pioneering research division, Du Pont. His successor as research supervisor in the chemical department at the Wilmington experimental station: **Allan K. Schneider** who has been a senior research worker at the station.

Kenneth C. Vincent. Supervisor of extraction metallurgy, Armour Research Foundation. Has been chief metallurgist for the Baroid Sales Div. of National Lead Co., Houston, Tex.

John Condry. Assistant laboratory director, eastern division, Standard-Toch Chemicals, Inc. Has been a senior chemist in the company's laboratories.

Setrak K. Derderian. Assistant general manager, Metal Hydrides Inc., Beverly, Mass. With the organization since 1943. Graduate of Bates College.

Ralph I. Dunlap. Assistant director of research, Monsanto's plastics division in Springfield. Joined the division in 1943 as a research chemist. Promoted to group leader in the research department in 1946. Became an operating superintendent

in the production department, 1941. In 1952, group leader in charge of styrene research, research department. Doctorate from Columbia.

Wilhelm Gruber. On the staff of the British Columbia Research Council. Formerly professor of chemistry at the University of Vienna.

Dan M. Guy. Director technical service of the newly organized product application division of Ethyl Corp. Head of engineering research: **Harold Gibson.**

W. R. Crute. A vice president of Champion Paper & Fibre Co. Division manager of the company's Texas operations since the plant was built in 1937.

Kurt C. Fisch. Supervisor of organic research at the Philadelphia headquarters of E. F. Houghton & Co. Has been a research chemist at the GE chemical division in Pittsfield, Mass., since 1944.

Isadore Perlman. Recipient of the California section award of ACS. Since 1949, professor of chemistry at the University of California. He is on the staff of the university's radiation laboratory at Berkeley.

Bernet S. Swanson. Executive officer, chemical engineering department, Illinois Institute of Technology. Has been assistant professor of chemical engineering since 1948. Doctorate from the Institute.

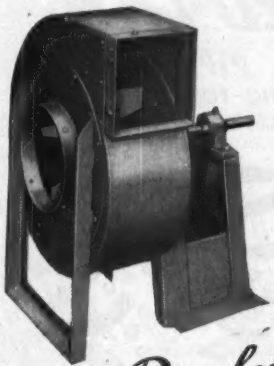
T. Wayne Warren. Supervisor of research in refinery technology at the Detroit research laboratories of Ethyl Corp. Has been on leave of absence from Humble Oil and Refining's technical service division to serve as an aviation fuels specialist for PAD in Washington. Graduate of the University of Texas.

Paul M. Dean. Retires as head of the chemistry department at the University of Colorado. Has been a member of the faculty for 43 years. Doctorate from the University of Illinois.

C. Arne Arenberg. Physical chemist at Armour Research Foundation. Formerly technical research adviser to the Catalytic Construction Co.,



WHETHER you require the removal of fumes, vapors, refuse —conveying of materials—air cleaning—or any other phase of plant or laboratory air handling, BAYLEY engineers may be relied upon to help you achieve the desired results. And BAYLEY Air Handling Equipment, properly designed and selected, will deliver trouble-free, ever-dependable service year after year. This fact is proved by the effective performance of BAYLEY Equipment in a wide field of industrial and technical applications.



Type "EX" Fan

- CENTRIFUGAL FANS
- AIR WASHERS
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Bayley BLOWER COMPANY
MILWAUKEE
Engineered Air Handling Equipment

BAYLEY BLOWER CO.
1823 S. 66th St., Milwaukee 14, Wis.

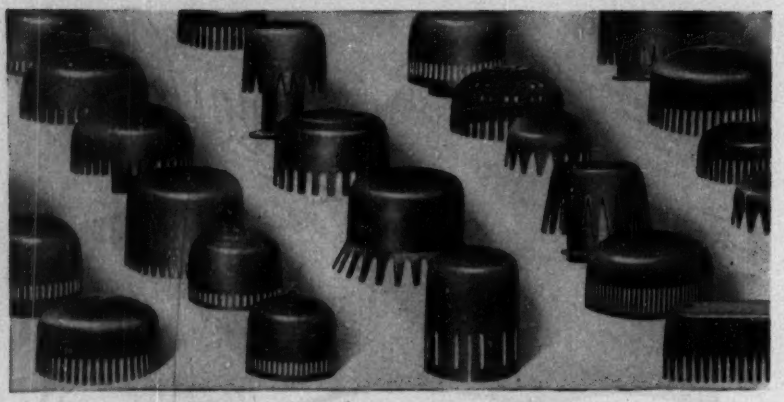
Please send illustrated bulletins covering Bayley Equipment for:

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☐ Process Conditioning ☐ High Temperature

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BUBBLE CAP BULLETIN 21

Largest Compilation of Engineering Data.

Lists 200 Styles Furnished Without Die Cost.

This standard reference contains complete specification information for over 200 standard styles of bubble caps and risers. Also drawings for use in determining methods of tray assembly. All styles listed in Bulletin 21 are furnished promptly, without die cost, and in any alloy to meet your coking or corrosion problems. Special caps gladly designed; write us to your needs.

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Custom Fabricators for the Process Industries Since 1928. Send Your Blue Prints



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EVERYTHING FOR A COMPLETE PORTABLE PIPE SYSTEM

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PIPE COUPLINGS—FITTINGS
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by one unskilled man. 2½ to 30 o. d. black or galvanized. Ready to lay—without delay.

Complete inventory of all Industrial Pipe, Valves, Fittings, and Flanges.

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Please send free booklet describing your Speed-Lay System and services:

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Philadelphia, Pa. Studied at the Illinois Institute of Technology and the University of Chicago.

Reynold C. Fuson. Recipient of the William H. Nichols Medal of the ACS's New York section. A professor at the University of Illinois, he is an authority on the chemistry of mustard gas and the synthesis of anti-malarial drugs.

Cyril S. Taylor. Retired after 23 years chief of the physical chemistry division, Aluminum Research Laboratories, New Kensington, Pa.

Walter A. Naumer. President of Pyrofax Gas Co., New York. With the company since its inception in 1926. Has been a vice president since 1950.

OBITUARIES

Gregory P. Baxter, 76, chairman of the chemistry department at Harvard from 1911 to 1932, died at Cambridge, Mass., February 10.

Luis H. Bartlett, head of the chemical engineering department at Oklahoma A & M, died on February 16. Prior to coming to A & M in 1951, he was on the faculty of Louisiana State University and had served as director of the engineering experiment station at the University of Texas.

O. Eugene Shostrom, 58, chemist for the National Canners' Assn. at Seattle died there February 2. He had been with the group for 34 years.

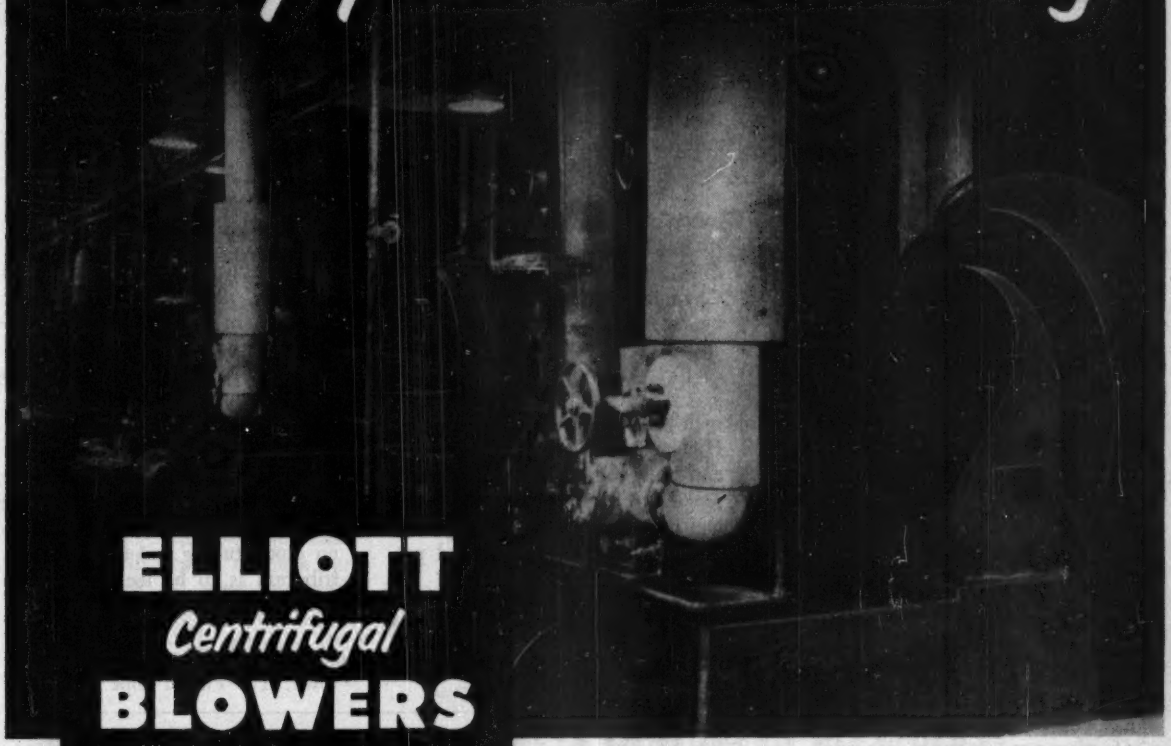
Russell W. Millar, 57, chief of the chemical engineering division of the Shell Development Co., Emeryville, Calif., died February 25.

Raymond J. Lakey, 34, vice president and chief engineer of Shea Chemical Corp., died February 26.

Charles L. Wakelee, 39, works manager of the Nyotex Chemical Co., Green's Bayou, Tex., died February 26.

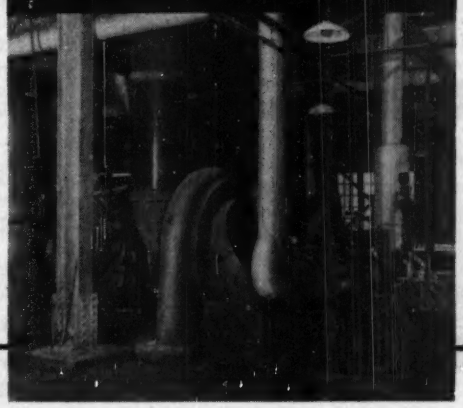
Wayman B. Jefferson, 33, Texas Co. chemical engineer, died in Port Arthur, Tex., March. 2.

Twenty years in a saline fog



ELLIOTT *Centrifugal* BLOWERS

ELLIOTT CENTRIFUGAL BLOWERS pull brine-saturated air for the U. S. Potash Company in separating potassium chloride from sodium chloride and other impurities. Photos show part of the line of eleven blowers, all still going strong, although the original units have served since 1932. Each blower is rated 12,640 inlet cfm, with an inlet pressure of about 23.0 in. Hg, absolute, discharging to atmosphere (barometer 26.5 in. Hg) and is driven at 3670 rpm by an Elliott steam turbine developing 160 hp.



Operation is non-stop 363 days per year, handling air that is saturated with brine resulting from the hot solution leaching process used in separating potassium chloride from the sodium chloride and other impurities with which it is found. After crystallization of the potassium chloride in the solution, it is filtered, during which the Elliott blowers located at the suction end of the filters draw heated air through the filter drums. The possible corrosive action of the brine-laden air is minimized by impellers of special alloy.

It is significant that twenty years of this rigorous service, with only occasional outage for maintenance, has no terrors for Elliott blowers. The original unit is still going strong.

For complete data on Elliott blowers, contact your local Elliott engineer, or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

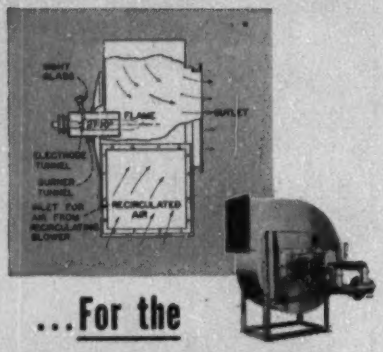
Centrifugal Blower Department

P3-3

'Surface'

DIRECT GAS-FIRED

air heaters



...For the Chemical Industry

SCROLL TYPE AIR HEATERS utilize the most efficient method of heating air or other gases by mixing the products of combustion directly with the air to be heated.

COMPLETE COMBUSTION assures that only small amounts of nitrogen, carbon dioxide, and water vapor are added. These compact heaters can be designed to operate against back pressures if required. Direct air heaters are available in 68 standard sizes with heat inputs from 250,000 to 6 million Btu per hour.

HAVE YOU AN APPLICATION? There are innumerable applications to which 'Surface' Air Heaters can be put in the chemical processing industries. Perhaps unknowingly you have one. Write for information.

SURFACE COMBUSTION
Corporation
TOLEDO 1, OHIO

'Surface' 'Kathabar' 'Janitrol'

( ) Send me further information on Air Heaters. CE-8H
( ) Send me information on:.....
.....
(Write here the application to which you think a 'Surface' Air Heater may be put)
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Industrial Notes

NEW NAMES

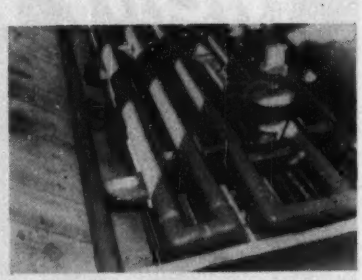
Midwest Piping and Supply Co. has changed its name to Midwest Piping Co. because its major business now, instead of supply, is the fabrication and installation of piping and manufacture of welding fittings.

Harmon Color Works, a division of B. F. Goodrich Co. has been consolidated with the B. F. Goodrich Chemical Co. division and will henceforth be known by that name.

NEW LINES

Stepan Chemical Co., Chicago—Higher fatty alcohols from tallow and other fats and oils to be called Makanols. A semi-works unit utilizing the sodium reduction process has been erected and limited production is under way.

Co-Polymer Chemicals, Inc., Detroit—Epoxy maintenance coatings to be known as Epoxyn Enamels.



Kraloy Plastic Pipe Co., Los Angeles—A new rigid vinyl plastic pipe shown here used as a cooling system for a waste water disposal line. The pipe is reported to be able to handle corrosive chemicals a 500 psi. working pressure, 77 deg. F.

Cox & Co.—A heating tape said to be the first on the market with a unique wrap around feature for application on pipes, tubing and fittings. Distribution is to be handled by Air Associates, Inc., Teterboro, N. J.

Atlas Mineral Products Co., Mertztown, Pa.—Plastic pipe based on

WANT THIS NEW CATALOG?



NEW ASCO CATALOG
Describes Scores of Solenoid Valves

New Valve Catalog No. 24 brings you up-to-date on the extensive ASCO line of Solenoid Valves (list prices are included). New valves developed and put on the market recently are described in detail *for the first time*. One of these is:



Bulletins 8262 and 8314
Midget Size 2 & 3-Way Packless Solenoid Valves
Midget Valves are now available with EXPLOSION-PROOF Solenoids for Class 1, Group D hazardous locations. 2-Way (Normally Open or Normally Closed) — Ports, 1/16" through 3/16"; pressures up to 1000 p.s.i. 3-Way — Ports, 3/64" and 3/32"; pressures up to 125 p.s.i. Time Delay Feature — Valves with 3½-6½ seconds delay also available.

These two are just examples of new valve data. If you have any need for controlling the flow of liquids or gases in the equipment you are designing or operating, you should find this up-to-date ASCO Valve Catalog useful. Want a copy? Just drop us a note or call up and let us know. We'll be glad to send it to you . . . and extras for your associates if you desire.

We manufacture a complete line of Electromagnetic Controls including Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and complete Control Panels.

V.53.1

To thousands of satisfied users, ASCO and Solenoid Valves are synonymous.

ASCO Solenoid VALVES

Automatic Switch Co.
381 LAKESIDE AVENUE • ORANGE, NEW JERSEY

high impact styrene in sizes ranging from ¼ to 6 in., outer diameter. Threaded fittings are available in sizes up to 2 in.

Strick Co., Philadelphia—Fiber glass reinforced polyster sheets in sizes up to 4½ by 8½ ft. and in a variety of thicknesses.

Atlas Mineral Products Co., Mertztown, Pa.—Armored pipe available in sizes up to 6 in. O. D. This wedding of thermoplastic and thermosetting pipe yields a unit which is said to be satisfactory for most corrosive solutions at temperatures up to 195 deg. F.

National Lead Co., New York—Corrosion-resisting valves and heat and acid-resisting castings through purchase of Pioneer Alloy Products Div.

Equipment Development Co., Montclair, N. J.—Filtration equipment which it will design, engineer and sell through an agreement with Sintering Machinery Corp., Netcong, N. J., which will manufacture and stock filtration units and parts.

Verona Chemical Co., Newark, N. J.—Imported and domestic dyestuffs, intermediates and auxiliary products which will be sold by its new division, Verona Dyestuffs, Union, N. J.

NEW REPRESENTATIVES

Fine Organics, Inc., New York, has appointed Standard Products, Inc., Wichita, Kans., as its exclusive selling agents for its aviation-industrial line in the states of Kansas, Oklahoma and Missouri.

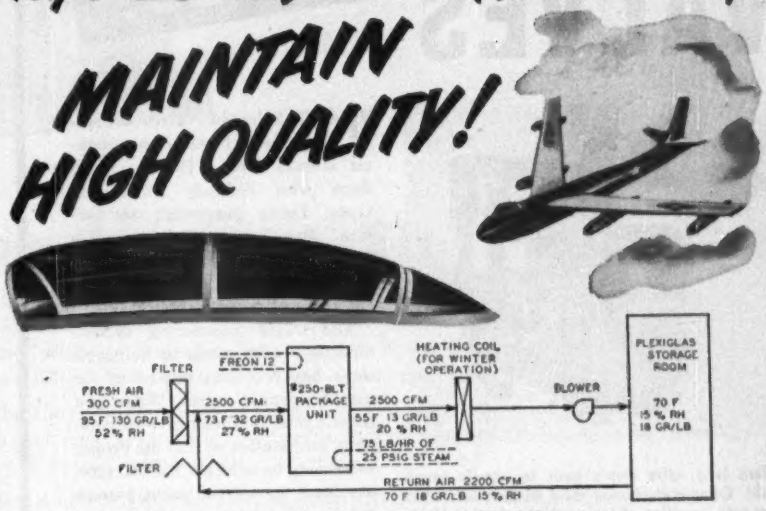
Coleman Engineering Co., Los Angeles, manufacturers of an electromechanical shaft position indicator used in readout systems where data are presented for visual reference, has appointed Beckman Instrument Co. as national distributors for their new products.

John B. Moore Corp., Nutley, N. J., has appointed new sales representatives for two territories. They are the Caldwell Chemical Co., New York, for eastern New York and Long Island and the James B. Schooler Co., Kansas City, Mo.,

Kathabar

helps GOODYEAR Aircraft Corp.

MAINTAIN HIGH QUALITY!



Above—Laminated Plexiglas aircraft canopy used on B-47. This is followed by a schematic flow diagram of air conditioning system for storage room.

70F 15% R.H. MAINTAINED YEAR ROUND PROTECTS LAMINATED PLEXIGLAS!

Laminated butyral-acrylic Plexiglas is mighty allergic to humidity. This is critical in the production of aircraft canopies such as made for B-47 bombers by Goodyear Aircraft. Without controlled humidity storage conditions, absorbed moisture vaporizes during high temperature forming and causes bubbles which destroy optical clarity . . . create distortions. One flaw of this nature could cause the scrapping of a canopy costing up to $1500.

However, by utilizing controlled low humidity air in the Plexiglas storeroom, Goodyear is able to produce crystal clear canopies of high quality. This air is delivered by a KATHABAR Humidity Conditioning unit. Conditions in this room are maintained at 70F with 15 per cent R. H.

SURFACE COMBUSTION *Corporation*

TOLEDO 1, OHIO

Kathabar — Humidity Conditioning Systems

Surface — Industrial Furnaces and Burners

Janitrol — Automatic Space Heating Equipment



OK ☐ Send me case histories and complete information on Kathabar humidity conditioning equipment.

☐ Send me information on .....
(Write here any special humidity problems you may have.)

Name.....

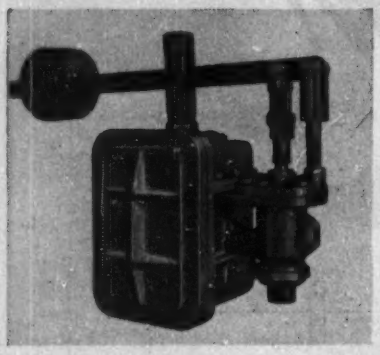
Company.....

Address.....

City.....Zone.....State.....

DAVIS *Solenoid* VALVES

Built to handle the toughest JOBS!



Here is a valve that's built to handle tough jobs. Completely sealed valve mechanism makes for safe handling of toxic or inflammable fluids or gases. Self-cleaning design due to simple interior large port area and downward outlet that allows natural gravity flow. Also has explosion proof housing for coil, renewable valve disc and visible action. Ideal for accurate control of fluids under tough conditions. Less maintenance required and longer, more economical service.

DAVIS Solenoid Valves are engineered to handle your toughest control jobs. Don't confuse them with ordinary commercial types. Davis guarantees satisfaction! The Davis Solenoid line is complete—standard and special designs are available for many different kinds of control applications.

The Davis engineering department is always ready to help you solve any problems regarding the use of solenoid valves. When you submit your problem, give us complete information so that the proper valve may be selected for the service. State the size of valve, pattern (globe or angle), nature of fluid or gas, temperature, maximum and minimum pressures, service use, whether valve is to be open or closed when energized, standard or explosion proof solenoid box and current characteristics.



No. 93

Davis No. 93 is a self-contained, pilot operated, single seated, tight closing valve, built with full port opening to insure maximum flow with minimum pressure drop. Action is visible—may be operated by hand if current fails. Renewable valve disc. Sizes ½" to 4". Suitable for control service on steam, air, gas, water or oil lines.

WRITE FOR A COPY OF THIS BULLETIN

Complete details and specifications on Davis' complete line of solenoid valves. Includes information on operation, applications and valves recommended for various kinds of service.



Davis REGULATOR COMPANY

2539 S. Washtenaw Avenue Chicago, Illinois

for Kansas, Oklahoma and western Missouri.

Bell Mineral Corp., West Paris, Me., which produces high quality grades of feldspar, has appointed Whittaker, Clark & Daniels, Inc., New York as its eastern sales representative.

Rust-Oleum Corp., Evanston, Ill. manufacturer of rust preventives, has appointed two new distributors: Clark-Fontana Paint Co., Washington, D. C., and Empire Supply Co., Jamestown, N. D.

Surface Combustion Corp., Toledo, has appointed Economy Equipment Co., St. Louis, Mo., as agents for the sale of standard industrial equipment in Missouri, Kansas and southern Illinois.

Schwartz Chemical Co., New York, has appointed Plastic Materials Supply Co., Temple City, Calif., as its West Coast distributor.

Orr & Sembower, Inc., Reading, Pa., manufacturer of packaged automatic boilers, has appointed Young-Streeter Co., Indianapolis, as its representative.

NEW LOCATIONS

Furane Plastics Inc. has moved to a new Los Angeles location at 4516 Brazil St.

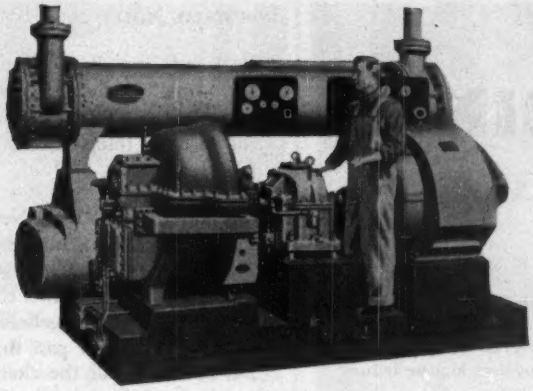
Barco Mfg. Co. has moved all its manufacturing and business operations to Barrington, Ill. A manufacturer of flexible joints for piping in industry, the company was formerly in Chicago.

Beckman Instruments, Inc. will move to a new $2 million plant between Ocean Ave. and Imperial Blvd., South Pasadena, Calif. The plant will be completed by mid-summer.

Nuodex Products Co. has moved its executive and administrative offices to 1 Virginia St., Newark, N. J.

NEW COMPANIES

Dixon Sintaloy, Inc., Stamford, Conn., to make powdered metallurgy parts involving a wide range of steel, semi-



How far down, Sir?

The industrial front is getting colder all the time. Newer processes — the manufacture of synthetics, for example — demand temperatures as low as minus 100 F. And minus 125 F. And even to minus 180 F.

The Carrier Centrifugal Refrigerating Machine is the perfect answer to such problems. It specializes in directly chilling any liquid, or condensing any vapor, at temperature levels down that far.

Here's how flexible the Carrier Centrifugal is. At ordinary temperatures it cools water or other liquids with two-stage compressors. At lower temperatures it chills brines with three stages. And if you're chilling chemical brines or liquefying vapors at ultra-low temperatures, the Carrier Centrifugal adapts to series staging or cascading. In short, all conceivable ranges can be covered by a Carrier Centrifugal.

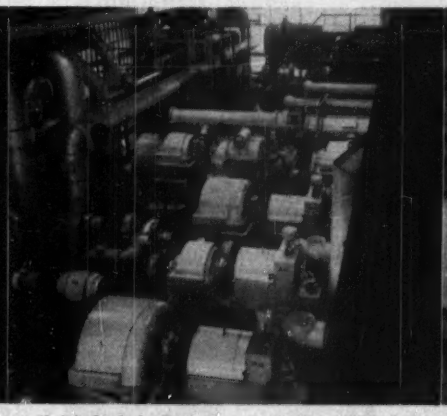
So how far down do *you* want to go? The Carrier Centrifugal Refrigerating Machine, available in a complete range of sizes to 2500 tons capacity, will take you there efficiently and economically.

And P. S. — during the past 30 years we've made 2500 multi-stage centrifugals, a lot more than anyone else. And each one of them is backed up with the largest, most experienced national service organization in the business. That's important.

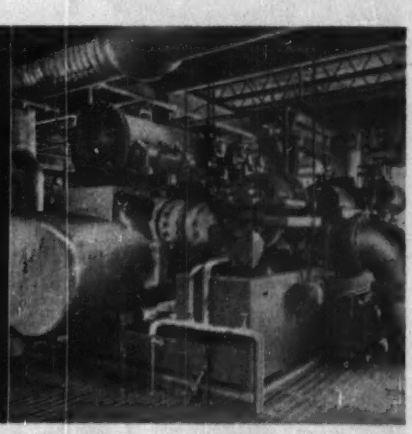
Want more information? Just check with the Carrier office nearest you, or write for our catalog, "Centrifugal Refrigerating Machines." Carrier Corporation, Syracuse, New York.

Carrier

AIR CONDITIONING
REFRIGERATION
INDUSTRIAL HEATING



At Kodak Park in Rochester, the Eastman Kodak Company depends on Carrier Centrifugal Refrigerating Machines for refrigeration at temperatures as low as minus 85 F.



Carrier Centrifugal Refrigerating Machines are used to chill calcium chlorine brine at the RFC synthetic rubber plant operated by the B. F. Goodrich Chemical Company at Port Neches, Texas.

CONSIDER

STEAM TURBINES

AS MOTIVE POWER

TO OPERATE
COMPRESSORS
PUMPS
FANS
BLOWERS
WINCHES
GENERATORS
MIXERS
AND
SIMILAR
EQUIPMENT

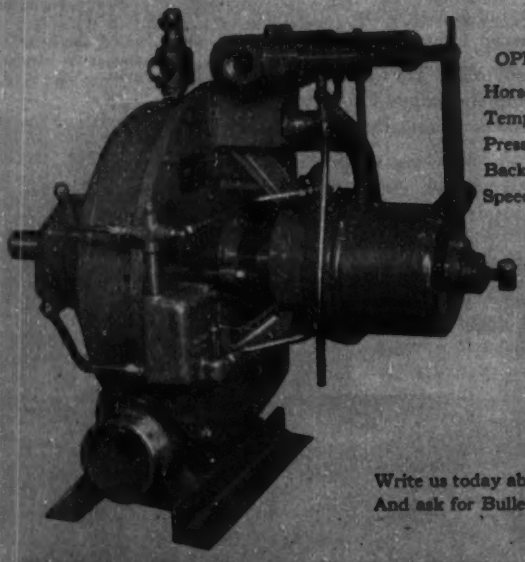
HERE ARE THE ADVANTAGES:

VERSATILE DEPENDABLE: Wing Steam Turbines give an infinite range of speeds, easily controlled by throttling. Always on the job, you are completely *independent* of any electric power failure.

ECONOMICAL: Wing Steam Turbines cost little or nothing to operate where their oil-free exhaust steam can be used in process operations—or in space heating. The Turbine acts as a reducing valve . . . its exhaust steam has been reduced down to the pressures used in heating and cooking operations.

NO SPARKS: Wing Steam Turbines are especially desirable for operations involving explosive gases and flammable materials, where sparks could be dangerous.

SMOOTH ACCELERATION OR DECELERATION: Wing Turbines can be smoothly accelerated or slowed down to meet the needs of the process, fan, pump or other driven apparatus.



OPERATING RANGES:

Horsepowers to	150 b.h.p.
Temperatures to	750°F.
Pressures to	600 p.s.i.
Back Pressures to	50 lb.
Speeds to	4000 r.p.m.

WING Steam Turbines have been serving industry for over a half-century. They are known for their rugged construction, trouble-free operation, and long life.

Write us today about further information. And ask for Bulletin SW-1a.

Wing

L. J. Wing Mfg. Co.

170 Vreeland Mills Road

Linden, New Jersey

Factories: Linden, N.J. and Montreal, Can.



steel and iron alloys together with high quality nonferrous alloys of many types. Dixon Sintaloy is a subsidiary of Joseph Dixon Crucible Co., Jersey City, N. J.

Henry Interdonati, Inc., New York, to act as a broker, sales agent and consultant, specializing in pharmaceutical and industrial chemicals, essential oils and insecticides. Mr. Interdonati for the past three years has been head of the chemical department of George Uhe Co., New York.

Timber Tech Corp., Eugene, Ore., to use wood laminates to manufacture arches, beams, truss chords, purlins and other structural frames.

W. M. Barnes Co. of Canada, Ltd., Toronto, to handle the increased activities of the parent, W. M. Barnes of Los Angeles, in the petroleum and chemical industries in Canada. For several years the Barnes organization has carried on construction work in Canada with the engineering and purchasing operations being conducted from Los Angeles.

Fluor Corp. of Canada to handle engineering, design and material procurement on all its parent company's new projects in Canada. The parent company is Fluor Corp., Ltd., Los Angeles engineers, constructors and manufacturers in the petroleum and allied chemical industries.

Jet-Vac Corp., an affiliate of the Artisan Metal Products, Inc., to design and manufacture ejectors and allied equipment.

NEW FACILITIES

Hilton-Davis Chemical Co., Cincinnati, Ohio—An expanded customer-service laboratory primarily to make technical know-how relating to color problems available to printing and printing ink firms.

Standard Oil Co. of California—A vacuum flasher with a capacity of 55,000 bbl. of reduced crude daily. The unit, which will get under construction in July, will be the duplicate of one (the world's largest) already installed in its Richmond, Calif., refinery.



M. W. Kellogg Co.—A new plant in Jersey City, N. J., to make fluorochloro-carbon plastics. It will add well over a million pounds annually to the supply of this material.

Raffineries Francaises de Petrole de l'Atlantique—An electrolytic caustic regeneration process to be installed at its Donges, France, refinery through a licensing agreement with American Development Corp., New York.

Timken Roller Bearing Co., Canton, Ohio—A multi-million dollar expansion for its Bucyrus, Ohio, plant. Completion is scheduled for the end of 1954.

Carbide and Carbon Chemicals Co., New York—A southern district sales office in Charlotte, N. C., for its textile fibers department.

Marietta Concrete Corp., Marietta, Ohio—A plant to be built at Hollywood, Fla., to make mortarless concrete block, precast concrete wall panels.

Allied Chemical & Dye Corp., New York—A $2.8 million building in Buffalo, N. Y., for the research and engineering staff of its National Aniline Div. Completion is scheduled for the spring of 1954.

Kaiser Aluminum & Chemical Sales, Inc., chemical division—Central division sales headquarters at Hammond, Ind., headed by R. L. Petersen.

Lindberg Engineering Co., Chicago—A plant in Downey, Calif., to manufacture industrial heat treating furnaces.

A. O. Smith Corp., Milwaukee—An Oakland, Calif., branch office to provide a central West Coast location for handling of replacement

IMPERVITE
Chemically Impervious PUMPS



MODEL 225
IMPERVITE PUMP
DELIVERS 25 GPM
Others up to 200 GPM

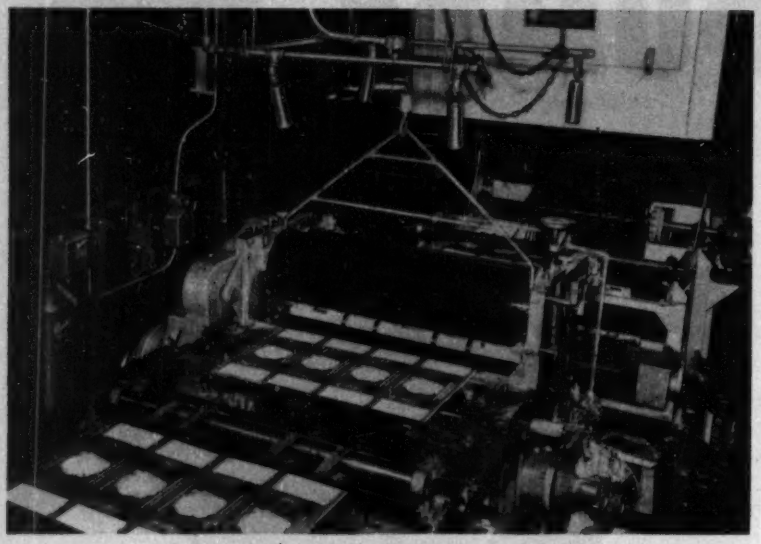
Through the portals of this new type pump pass the most vicious corrosives in chemistry . . . with an irreducible minimum of effect on its operation. The result is a new record in bulk of chemicals moved in proportion to service stoppages. All chemically contacted components are made from Impervite, Impervious Graphite, the most durable material known for surfaces exposed to destructive liquids or gases. Even such a tough corrosive as Hydrochloric Acid leaves Impervite unaffected. Among other exclusive features of this pump . . .

Can be dismantled without disconnecting pipes.
Impeller and shaft remove without disturbing motor.
Single-gasket, internally-cooled rotary seal.
Provides smooth constant flow of pure fluid.

Maximum delivery in ratio to horsepower.
Minimum down time for servicing.
Quick and easy replacement of critical parts.
Modern, compact, streamlined design.

Falls Industries, Inc.
AURORA ROAD · SOLON, OHIO

SHERWIN-WILLIAMS INSTALLS RANDOLPH AUTOMATIC FIRE SYSTEM



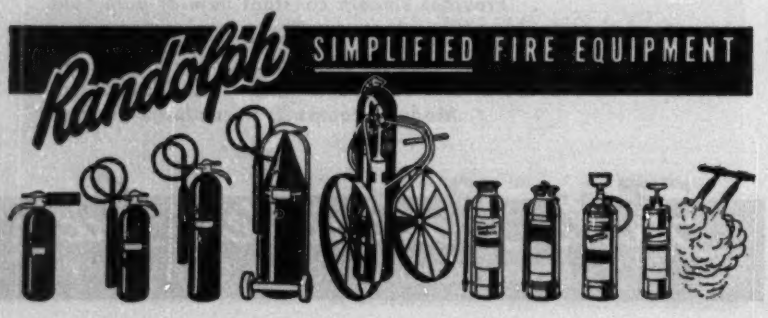
The Sherwin-Williams lithographic equipment presented an unusual and worrisome fire hazard, but this Randolph Automatic System not only automatically detects and extinguishes any fire that might occur, but also shuts down the equipment.

Kills Fire, Sounds Alarm and Shuts Down Machinery

As in the Sherwin-Williams installation, Randolph Systems, in addition to automatically killing the toughest fires in split seconds, can also be equipped with duct and door closers, motor, fan and machinery shut-offs, warning alarms and other auxiliary safety devices. Systems are designed for both local application or total room flooding and are ideal for dip tanks, baking ovens, spray booths and hundreds of other applications.

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International Glass Corp., Los Angeles—A plant in Newport, Ark., for production of glass fiber and glass fiber pipe wrap, battery retainer and separators. The plant was purchased from Perrault Glass Fiber Corp.

Air Reduction Sales Co., New York—A liquid oxygen plant in Butler, Pa., with a rated capacity of 100 tons a day. The plant will also produce argon and nitrogen.

Allied Chemical & Dye Corp., New York—A plant in Greensboro for its Barrett Div. to manufacture urea-formaldehyde resins. The plant formerly belonged to Synvar Southern Corp.

Harvey Machine Co.—A aluminum reduction mill at The Dalles, Ore., to produce 54,000 short tons of ingots. Construction is scheduled to start by summer.

R. S. Aries & Associates, New York—A branch office in San Juan, Puerto Rico, to be headed by Fernando Badrena, Jr.

Lee Rubber and Tire Corp., Youngstown, Ohio—A new southwestern district for its Republic Rubber Div. with headquarters in Tulsa, Okla.

Ansul Chemical Co., Marinette, Wis.—Branch offices in the Houston, Dallas-Fort Worth and Tulsa area.

Westinghouse Eelectric Corp., Pittsburg, Pa.—An Atlanta, Ga., branch office to be headed by Thomas Fuller, Jr.

Texas Eastern Transmission Corp.—A 14-story office building in Shreveport, La.

Allied Chemical & Dye Corp., New York—A $2 million research laboratory to be built at Morristown, N. J., for its General Chemical Div.

Stanolind Oil and Gas Co.—A four-building research center being built in Tulsa, Okla. —*End*

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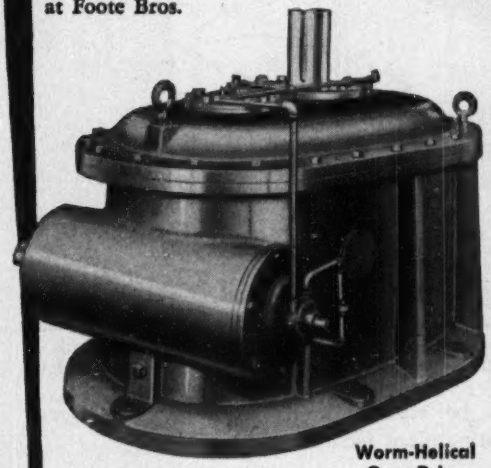
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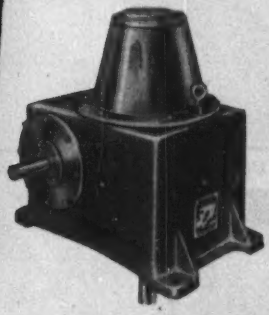
Worm-Helical Gear Drive



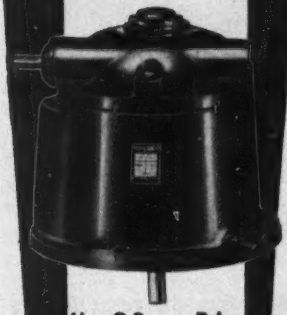
Foote Bros.-Louis Allis Gearmotor Extended Shaft



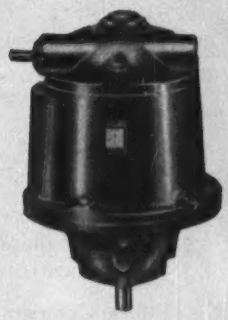
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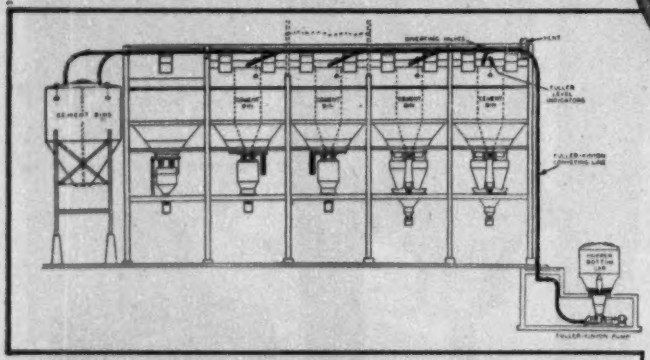
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City.....Zone.....State.....

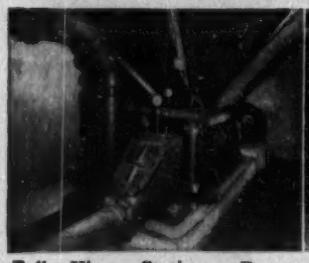
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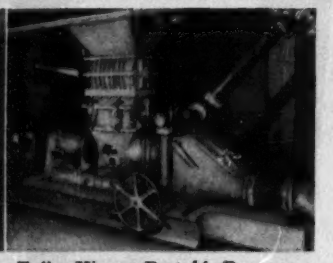
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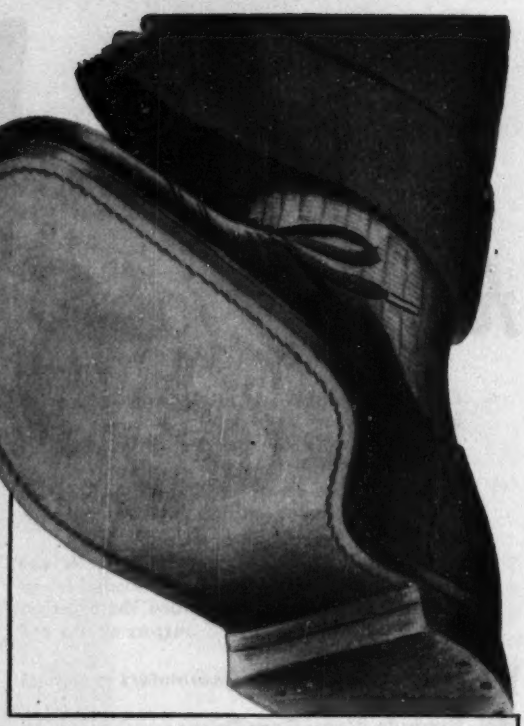
Unloading cement from hopper car; conveying to six delivery points

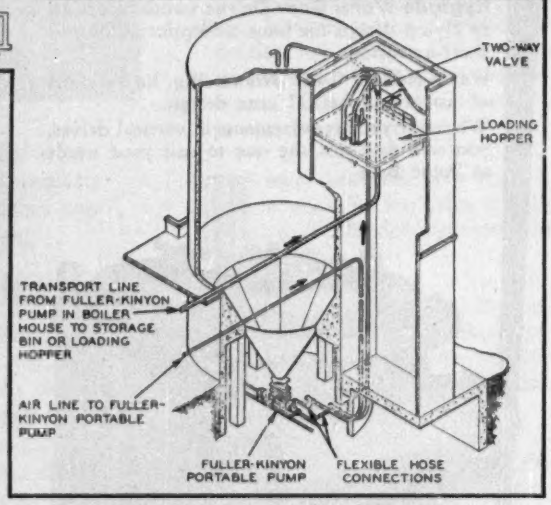


Fuller-Kinyon Stationary Pump conveying from bin to process equipment



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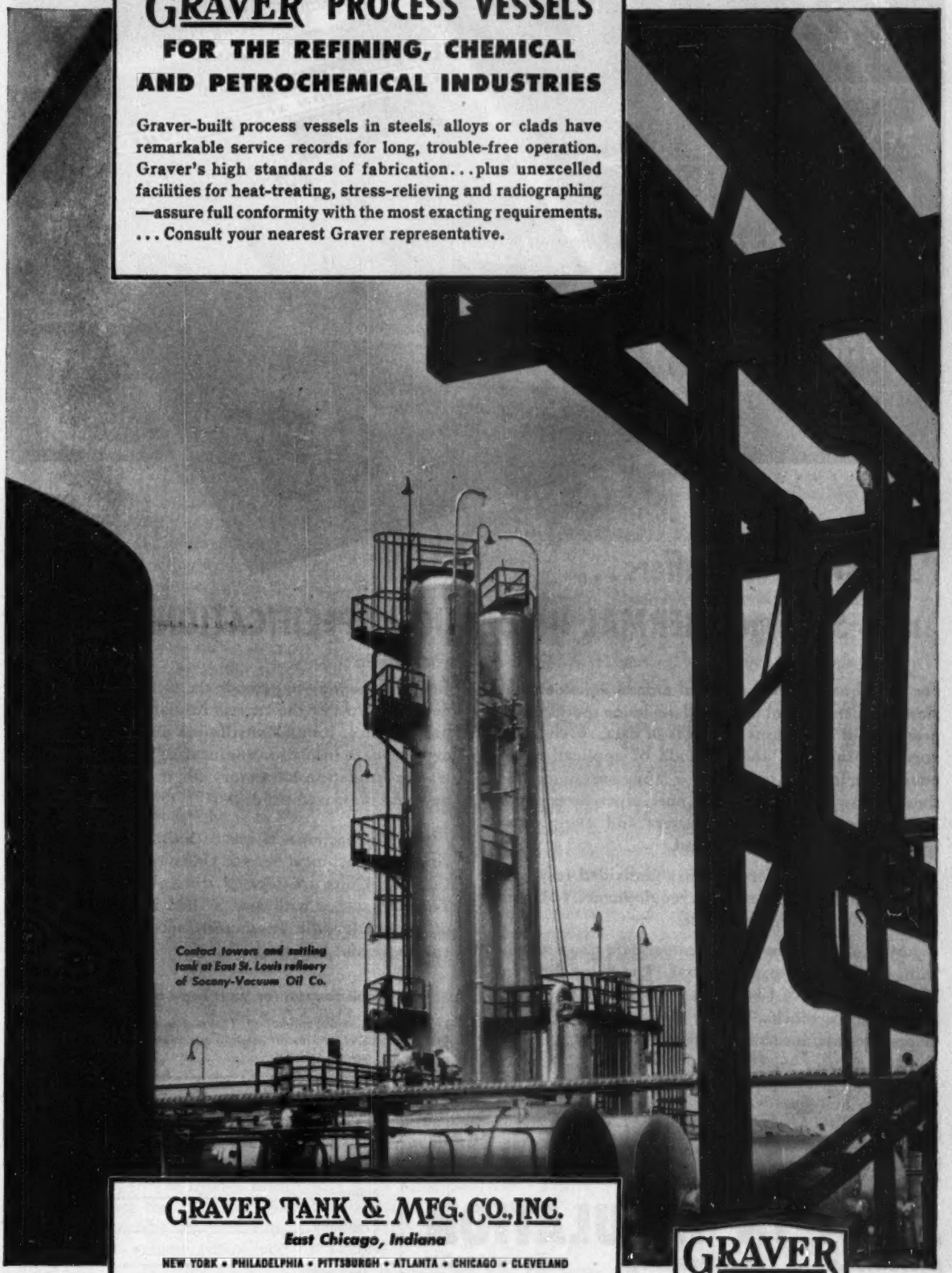
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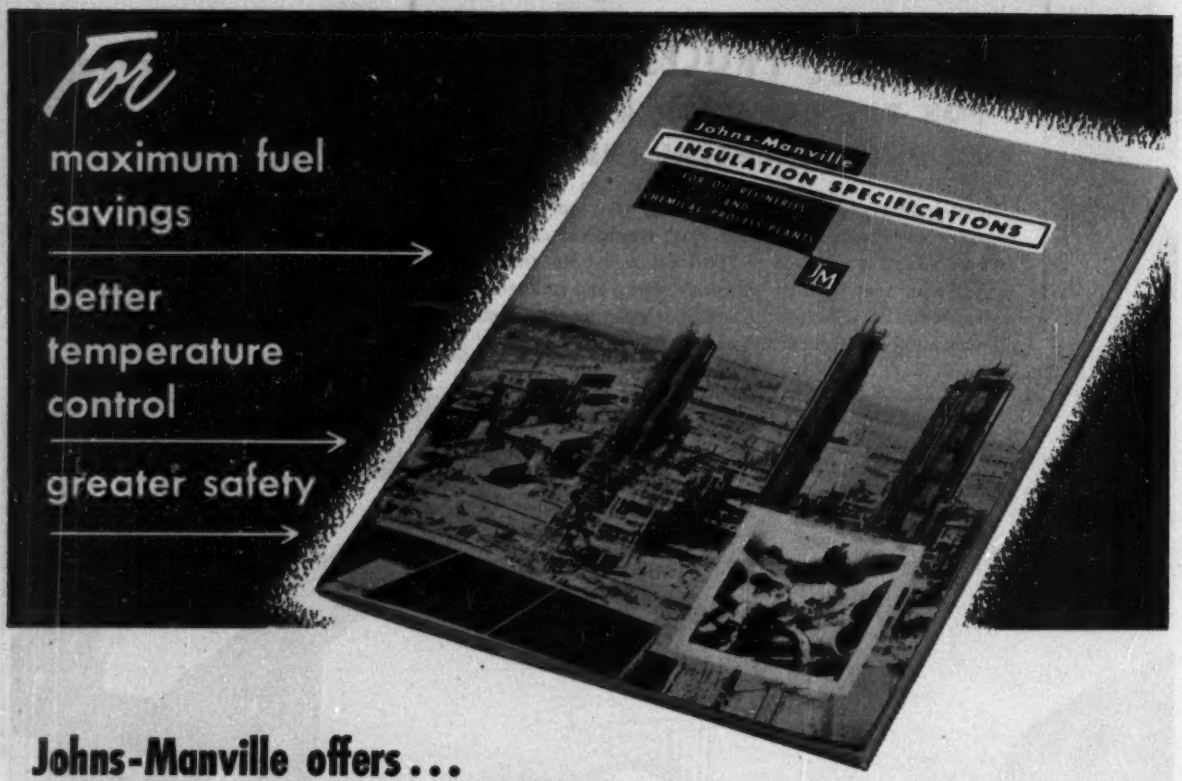
Contact towers and settling tank at East St. Louis refinery of Socony-Vacuum Oil Co.

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Chemical Engineer's Bookshelf

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Nine of Thirteen

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY. Vol. 9: Metal Surface Treatment to Penicillin. Edited by Raymond E. Kirk and Donald F. Othmer. Assistant editors: Janet D. Scott and Anthony Standen. Interscience Publishers, New York. 943 pages. Subscription price $25.

It takes only a brief study of Vol. 9 to see that the editors and publisher have put the clamps on their authors. The sections are shorter. Longest (mixing and agitating) is 34 pages and there are only four sections longer than 30 pages.

We remember that in earlier volumes the entries were longer. Cyanides we reported to you were 66 pages, dyes 128 pages. Another evidence of condensation: this volume has 65 entries while Vol. 8 has only 50.

▶ **Cost**–Which leads us again to the question: What is this encyclopedia going to cost? At a subscription price of $25, 10 volumes will be $250 and 14 will be $350.

In commenting on Vol. 6, I said the set was half ready–that's what the publisher told us. On Vol. 7 I again said we were halfway through–that was my guess. Now at the Vol. 9 mark I guess there will be 13 volumes. Look here:

Volume Number	Percent of Completion
1	8.1
2	11.0
3	24.4
4	29.8
5	39.6
6	42.5
7	49.6
8	60.0
9	69.8

The percentage of completion figures are my estimates. (They're based on a comparison with numbers of entries in chemical dictionaries.) If you plot these data you will see that continuing the present rate gives 100 percent at 12 volumes. The trend, however, is toward 13. The latter is more likely considering the upcoming and probably long entries for petroleum, potassium and sodium compounds, sulfuric acid.

At $25 each, 13 will be $325 plus index. (Don't forget it will be income-tax-deductible.)

But let's get back to Vol. 9. In it 97 authors are writing for you about 68 subjects.

▶ **Chemicals and Materials**–With 75 percent of the entries and the space, chemicals and materials are in greater prominence in this volume. And, since the articles are shorter, they are probably better. Take the first one, for example, methanol. It was authored by Yeandle, Sanders and Zeisig of Spencer Chemical Co. In 30 pages they tell you almost everything you could want to know: history, uses, properties, reactions, manufacture, synthesis thermodynamics and kinetics, processes, purification, materials of construction, producers, prices, specifications, analysis, storage, shipping, safety and uses. Truly a comprehensive roundup.

The next entry is methylamines. This is a five-page job by Spence and Riddle of Rohm & Haas. They cover their assignment in somewhat shorter fashion. But there is considerably less information available and the three amines are industrially less significant than the methanol from which they are made.

And so it goes. Mica, mineral wool, molasses, molybdenum, naphthalene and on to penicillin. Molasses was written by the outstanding authority and our old friend G. T. Reich. Nickel, by Mudge and Friend, is as good as you would expect from these Inco engineers. Nitric acid, by Barnes of Lion Oil, includes a brief description of the new Wisconsin thermal process.

For a literate evaluation of the intriguing analogies between water and ammonia, see the four pages on the nitrogen system of compounds.

Nuts. Here is the kind of survey article that adds flavor to our Encyclopedia. It has the personal appeal that makes one read with interest "A pound of nut kernels is equivalent to 12.3 lb. of white potatoes." "Production of edible tree nuts (1949) . . . 1.66 lb. per person in the U. S."

▶ **Theory**–In Vol. 9 there are four sections of what we may call theoretical surveys. They average 17 pages in length and include molecular structure, nucleonics, osmosis, oxidation-reduction.

The first, by our friend F. C. Nachod of Sterling-Winthrop, is concerned with parachor, dipoles and other physico-chemical aids to structure determination. Nucleonics–that term was introduced in 1944–covers all facts and conjectures concerned with atomic nuclei, directly or indirectly. Osmosis has more to it than you remember from college–look it up and see if I'm not right. Ditto "oxidation-reduction." You'll be surprised.

▶ **An Even Dozen**–There are 12 entries that are neither materials nor pure theory: metal surface treatment, microanalysis, microorganisms, microscopy, mixing, nitration, nomenclature, nomographs, organic analysis, packaging, packing materials, patents.

The first of these is the lead-off survey in the book–fine roundup of commercial practices. It includes cleaning and pickling treatments for metals and other ways to change the surface chemically. (Electroplating is in Vol. 8.)

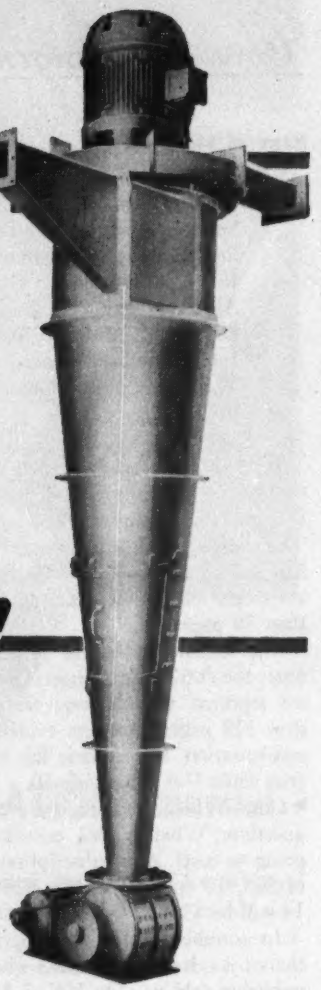
One of our most important unit operations, mixing, is thoroughly covered by J. H. Rushton. As engineers we applaud the editors' decision to let this article become the longest in Vol. 9. Principles, equipment and practices are described. (For costs of mixers, see *Chem. Eng.*, Jan. 1953, p. 191.)

The article by Benenati on nomographs is remarkably complete in 22 pages. When you master its expanded and basic determinants, you'll find nomography fairly simple. And valuable, too, for application when many calculations, all of the same type, are to be performed.

▶ **More**–I've left out any discussion of a lot of fine articles and surveys: nitration, nitric acid, organometallic compounds, oxo processes, paint, paper. They are all good. And when you want to know something about anything between MET and PEN, look first in Vol. 9.

The encyclopedia (Vol. 6) doesn't have much of value about first aid. But for another kind of trouble it will be a big help. See paint removers (Vol. 9, p. 803).–*LBP*

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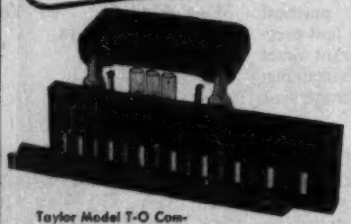
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Financial Management	Problems and prospects of industrial development at home and abroad. Includes papers covering a long-range view of business prospects, recent trends in corporate finance, incentives and obstacles to foreign resource development, cooperation between public and private finance. 28 pages.	Financial Management Series, No. 101. American Management Assn., 330 West 42nd St., New York 36, N. Y. $1.25.
Executive Training	How to develop management leadership for a free society. Papers on the problems of management in a large decentralized organization and the effectiveness of education for management. 30 pages.	General Management Series, No. 159. American Management Assn., 330 West 42nd St., New York 36, N. Y. $1.25.
Production Efficiency	Two booklets. One on new solutions to production problems contains papers on: industrial operations research; predetermined motion-time values as a new tool; the importance of human relations research for industrial productivity. 28 pages. The other covers methods for organizing for defense production and for relieving the engineering shortage. 42 pages.	Manufacturing Management Series, Nos. 200, 201, respectively—see summary. American Management Assn., 330 West 42nd St., New York 36, N. Y. $1.25 ea.
Air Pollution	Effects of weather on air pollution. How to assure the most economical solution to a problem by weighing the cost of reducing emission of the contaminant against the cost of increased stack height. 40 pages.	"The Meteorology of Air Pollution." By E. Neil Helmers. Manufacturing Chemists' Assn., 246 Woodward Bldg., 15th and H Sts., N.W., Washington 5, D. C.
Safety	How to guard against the spontaneous ignition and dust explosion hazards of certain soybean products.	Bulletin of Research, No. 47. Underwriters' Laboratories, Inc., 207 East Ohio St., Chicago 11, Ill. Gratis.
Paint	How to compare the paint-bonding characteristics of four types of phosphate pre-treatments on steel. Discusses and evaluates tests for profile, stripping weight, and actual paint-bonding effect after prolonged salt-fog exposure. Charts and photographs. 12 pages.	"Methods for Comparative Evaluation of Paint Bonding." By Max Kronstein, L. F. DeLong and A. W. Norman. Office of Information Services, New York University, University Heights, New York 53, N. Y. 35 cents.
Water	The recovery of ground-water levels in Brooklyn, N. Y., from 1947 to 1950. Detailed water-level data, contour maps, profiles and hydrographs of ground-water levels are presented and discussed. 29 pages.	Circ. 167. By Norbert J. Lusczynski. Geological Survey, Washington 25, D. C. Gratis.
Metallurgy	Industrial applications involving the heat treatment of metals. Links cur-	"La Pratique des Traitements Thermiques des Métaux In-

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Metallurgy	A review of published information on the physical chemistry of copper smelting. Includes chapters on the outline of the smelting process, the constitution of copper smelting slags, the formation of magnetite, copper losses in smelting and converting. 156 pages.	"The Physical Chemistry of Copper Smelting." By R. W. Ruddle. Institution of Mining and Metallurgy, Salisbury House, Finsbury Circus, London, E.C. 2, England. 10s.
Research	History and program of this nonprofit organization for basic research in medicine, biology and agriculture. 38 pages.	Southwest Foundation for Research and Education, 8500 Culebra Rd., San Antonio 6, Tex. Gratis.
Sugar	Report on an investigation of the factors that influence the rate of deterioration of granular sugar refining adsorbents with use. Several graphs present test data. 8 pages.	"Granular Adsorbents for Sugar Refining." By E. P. Barrett, L. G. Joyner and P. P. Halenda. Mellon Institute of Industrial Research, 4400 Fifth Ave., Pittsburgh 13, Pa. Gratis.
Organic Chemistry	Descriptions and prices of selected German patent applications of recent date in the field of organic chemicals. Subjects covered range from the purification of acetylene to the manufacture of such compounds as phthalodinitrile and quinoline. 8 pages.	Bulletin 76. Research Information Service, 53 Nassau St., New York 38, N. Y.
Chemical Economics	The program of financial planning and controls used by Monsanto Chemical Co. Broken down into: financial planning, accounting control, accounting research. 54 pages.	Financial Management Series No. 103. American Management Assn., 330 West 42nd St., New York 36, N. Y. $1.25.
Electrical Contacts	Bibliography covers articles on contract materials and methods of testing on the interruption of electrical circuits, covering the period from 1835 up through most of 1951. 266 pages.	Special Technical Publication No. 56-G. American Society For Testing Materials, 1916 Race St., Philadelphia 3, Pa. $5.50.
Northwest Industry	Industrial location facts on this area. Covers population, transportation, electric power, water supply, fuels, taxation, plant sites, climate. 21 pages.	"The Dalles Dam Area, Oregon-Washington." Ivan Bloch and Associates, 611 Park Bldg., Portland, Ore.
Rubber	Fourth report to the president and to the Congress covering operations under the Rubber Act of 1948. Chapters on world production, consumption and stocks of natural rubber, allocations of GR-S and butyl, synthetic rubber plant expansions and prices, U.S. rubber position. Statistics. 48 pages.	"Rubber—Fourth Annual Report by the Secretary of Commerce." Supt. of Documents, Washington 25, D. C. 20 cents.

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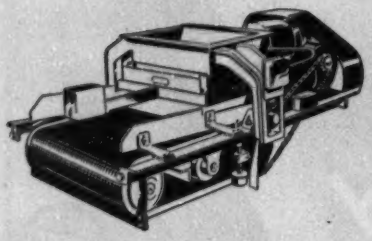
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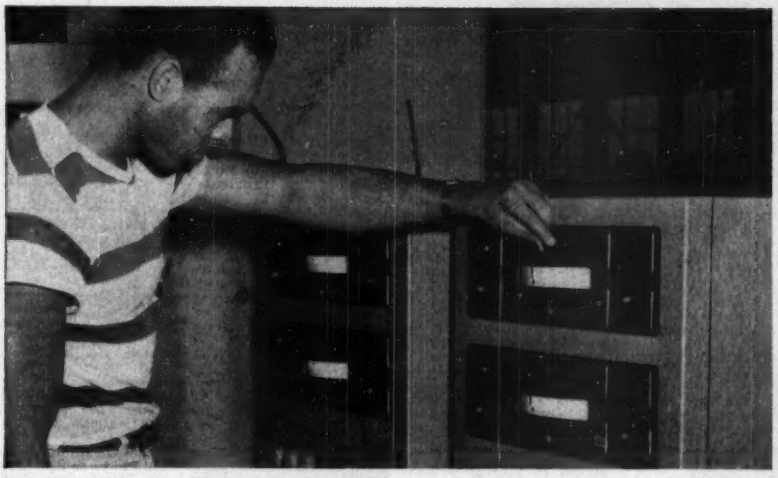


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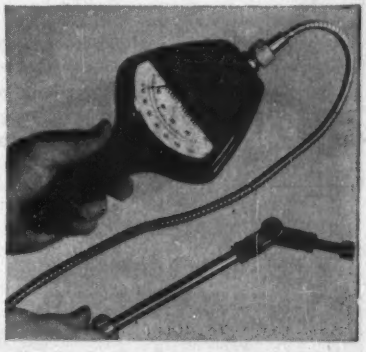
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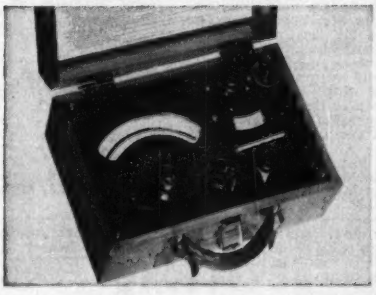
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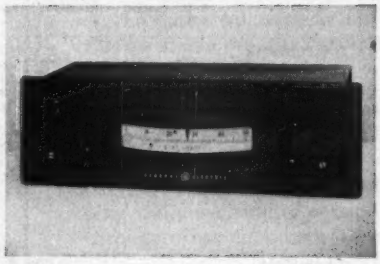
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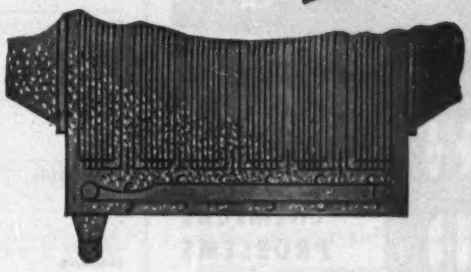
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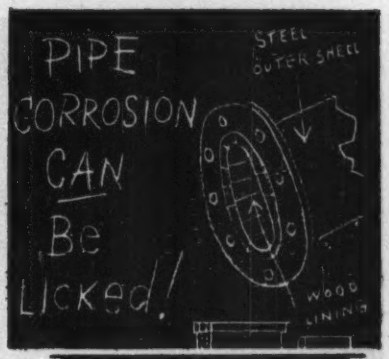
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Materials Handling	. . . move railroad cars and other heavy loads, including both vertical capstan and horizontal drum designs with car spotters and car pullers. Complete line is described; typical layouts show positioning. 24 p.	Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.
Boilers	. . . provide yourself with boilers for use wherever steam is required for applications other than power. Photographs, specifications of various models. 4 p.	Boiler Engineering and Supply Co., Phoenixville, Pa.
Research	. . . put ideas to work. Describes the mechanism used by Battelle. 16 p.	Battelle Development Corp., 505 King Ave., Columbus 1, Ohio.
Instruments	. . . choose standard and special testing instruments for the paint, varnish and other industries. Descriptions and illustrations of 100 items made or sold by this company. 48 p.	Gardner Laboratory, Inc., Bethesda 14, Md.
Instruments	. . . supply your needs from a complete line of steam, gas, air, oil and water regulating equipment. Specifications, operational data and prices. Capacity tables and flange charts. 60 p.	O. C. Keckley Co., 400 West Madison St., Chicago, Ill.
Valves	. . . insure dependable and explosion-proof operation through the use of this company's shut-off valves. 4 p.	Valco Inc., 1410 West St., Cincinnati 15, Ohio.

—End

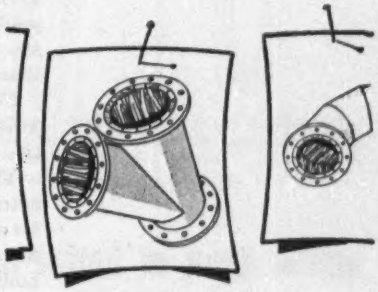


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For service up to 180° F. and 250 p.s.i. Higher pressure ratings for special service requirements. All pipe flanged and available in 10' and 20' standard lengths or "tailor-made" to your specifications. Easy to cut and reflange. All flanges have standard ASME bolt circle.



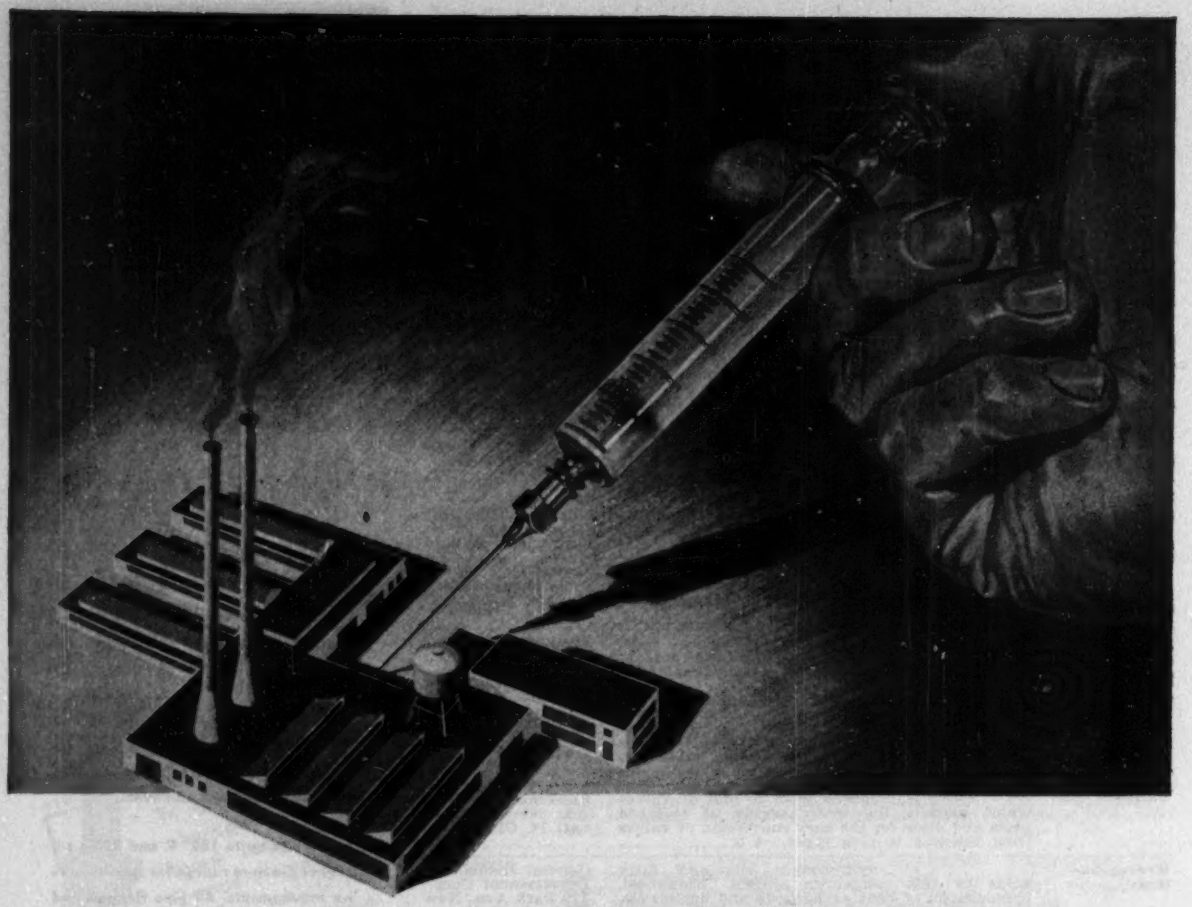
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Perhaps, like many producers these days, you've found today's heavier demands are asking more from your equipment than it can produce.

Consider how one typical company injected new productivity into *its* operation:

This was a soap processor who needed extra production and new fuel economy for a process involving crude with a high salt content. Development of a specially-built still pot of economical clad steel eliminated need of multiple distillation . . . reduced fuel and maintenance . . . speeded up heating . . . ended corrosion . . . provided structural strength to withstand vacuum—*and cut first equipment cost, too.*

What makes this story significant is that it resulted from a progressive planning method followed by certain Equipment Builders.

These specialists bring leading engineers, designers, and materials suppliers into the planning of your equipment. Each factor affecting performance *is thought out by a specialist in that field.* And in such planning, you'll find these builders turning to Lukens for its knowledge of materials, as well as its wide range of low-cost clad steels.

Even with new equipment often difficult to get these days, we know builders who can recondition what you have for better performance, better profits. Write us today, explaining your need. Manager, Marketing Service, 402 Lukens Building, Coatesville, Pennsylvania.

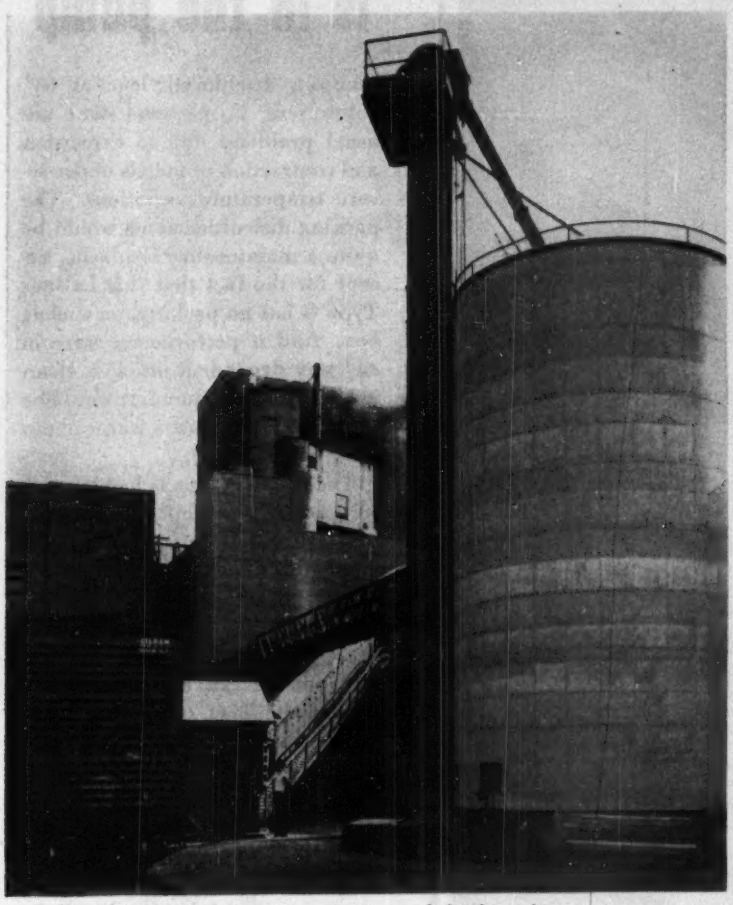
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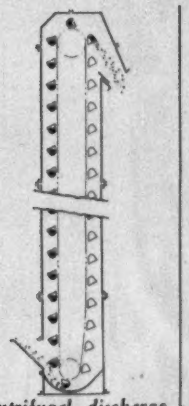
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LUKENS STEEL COMPANY, COATESVILLE, PA.

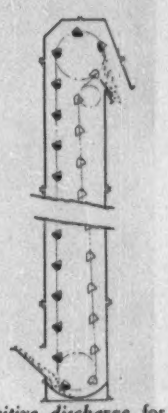
13 types...4 basic designs
to meet your elevating requirements



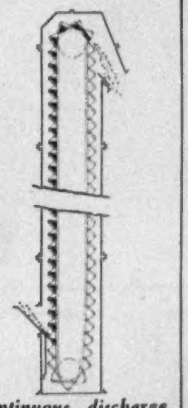
Link-Belt screw conveyor and bucket elevator handle material from railroad car to storage silo



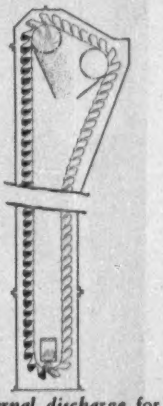
Centrifugal discharge for free-flowing, fine or loose materials with small to medium lumps.



Positive discharge for light, fluffy, fragile or any materials that tend to stick to the buckets.



Continuous discharge for many materials — light to heavy, small to large, abrasive lumps.



Internal discharge for gentle handling of small articles such as pellets, rivets, seeds, castings.

Let LINK-BELT recommend the bucket elevator best-suited to your needs

WHERE large or small quantities of bulk materials must be elevated in limited space, a bucket elevator is the equipment you need in most cases. And, in every case, you'll find the one that can do the job for less in the complete Link-Belt line.

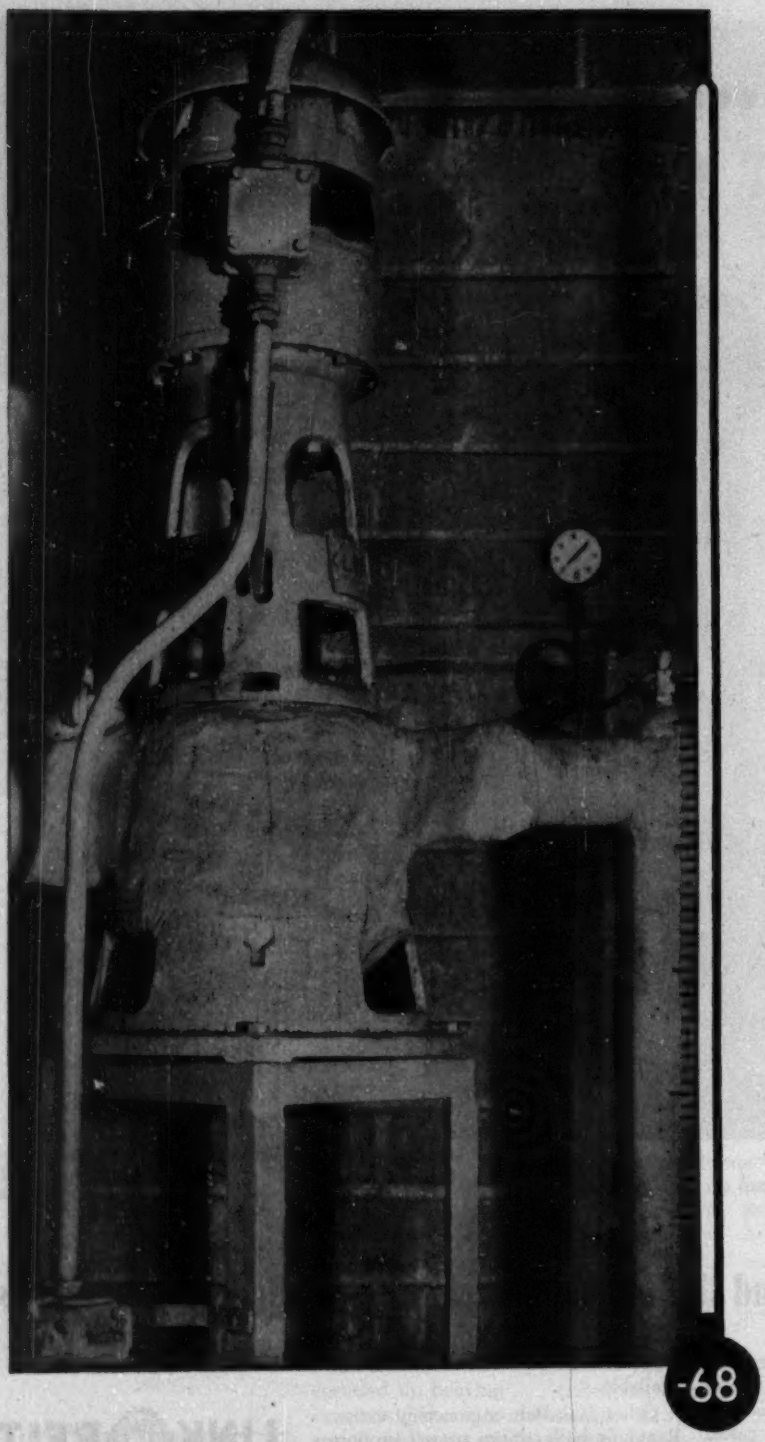
Link-Belt builds a type and size of bucket elevator for every requirement. Included in the 4 basic designs are 13 types of bucket elevators designed to suit a variety of materials. A wide range of sizes on chain or belts is also available.

Other Link-Belt engineering extras: Rigid, jig-built casings are self-supporting requiring only occasional lateral tie-ins depending on height. Periodic inspection is speeded with easy access to both head and boot. Chain or belt tension is maintained at all times with simple screw or gravity take-ups. You can get complete engineering information from the Link-Belt office near you.

LINK-BELT

BUCKET ELEVATORS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13.213-A



When the FROST is in the pump

Pumping trichlorethylene at 68° below zero, F., presents some unusual problems due to expansion and contraction of metals under severe temperature variations. The packing difficulties alone would be quite a maintenance headache, except for the fact that this LaBour Type G has no packing, no stuffing box. And if performance were in any way dependent on close clearances within the pump, it would be quite a trick to start a warm pump after a shut down.

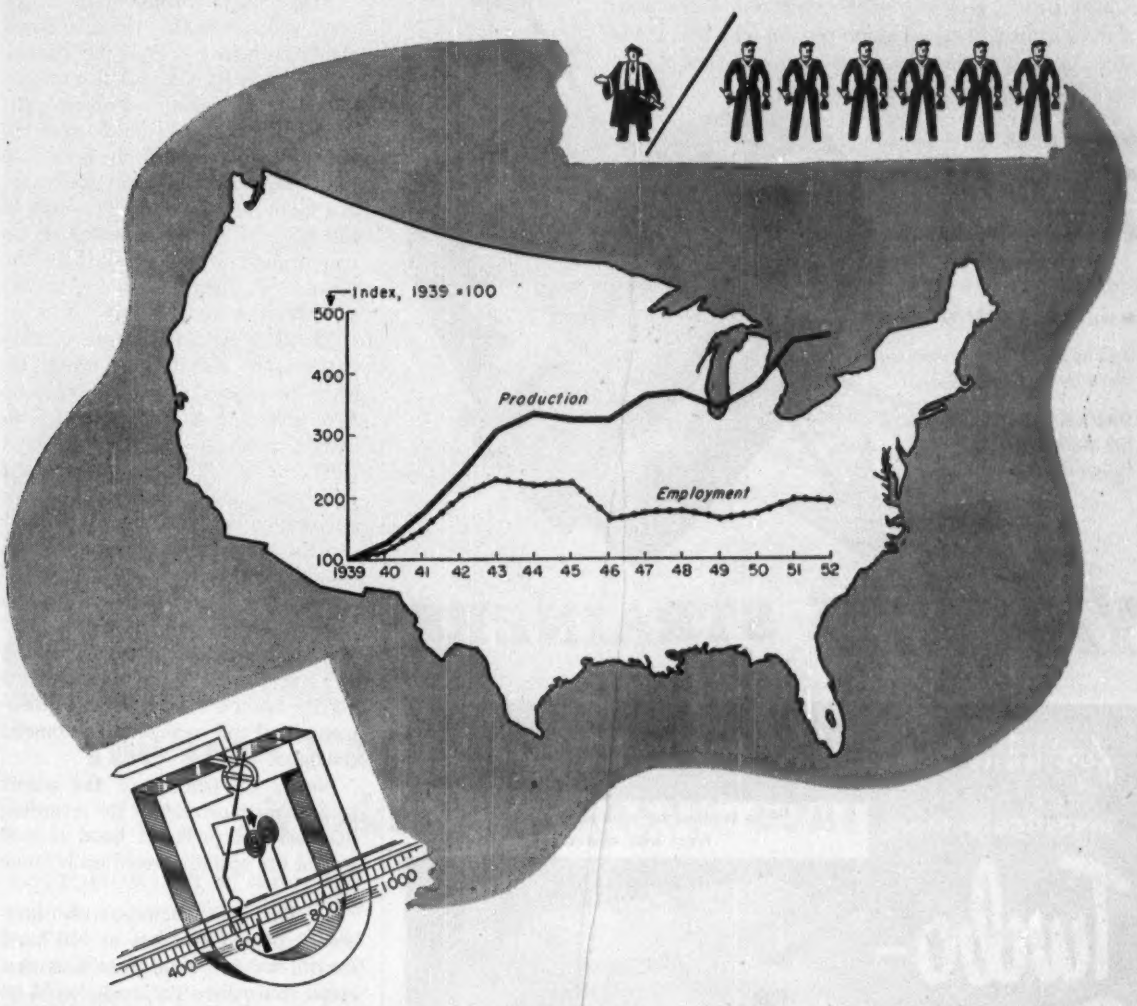
The LaBour Type G handles this job perfectly without a bit of trouble. Being self priming, it cannot vapor bind at any temperature which permits liquid to exist as such within the pump. No temperature variation as between inside and outside can cause it to leak around the shaft, nor can temperature extremes affect its sealing action.

Of course this is not a common application. But LaBour pumps do the uncommon jobs easily because they've been designed and built by a company which has lived with the chemical industry's liquid handling problems for nearly 30 years. If you can't afford to take chances with your pumping equipment, you can't afford anything less than a LaBour.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.



British Take Notes on What Makes Us Terrific

A team of industrialists has just completed a tour of our chemical plants trying to pin down the techniques that help our workers turn out more than twice as much as theirs.

What impression would a visitor from overseas—one familiar with the nature of the chemical industry—gain from a tour through American chemical plants?

Part of the answer is furnished in a report—*Heavy Chemicals*—prepared for the Anglo-American Council of Productivity by 17 representatives of the British chemical industry.

Here's a rundown on the main observations made by this distinguished group of visitors:

PRODUCTIVITY

American management doesn't worry about productivity as such. Only one plant maintained a complete set of performance charts. Industry leaders here concentrate on keeping output high, materials efficiency good and costs low. If these targets are met, productivity will take care of itself.

The observers concluded—after analyzing a whale of a lot of production data—that the U.S. chemical industry was able to produce 2½ times more per employee than the British. The report emphasizes repeatedly that higher capital outlay per worker and dynamic management are the main reasons for the advantage held by this country.

PERSONNEL

In the U.S. chemical industry there is one technically qualified employee for every six people on the payroll. In Britain the ratio is 1:16. The visitors

heart of the strainer

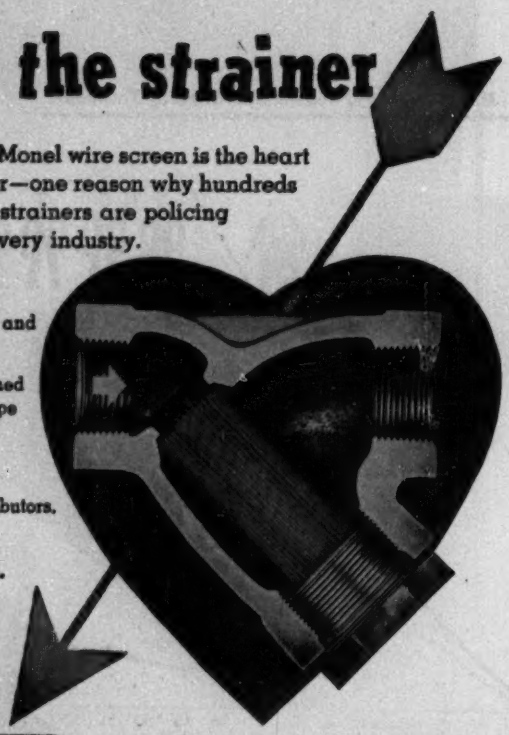
A high-grade, woven Monel wire screen is the heart of the Yarway Strainer—one reason why hundreds of thousands of these strainers are policing pipe lines in nearly every industry.

OTHER REASONS—

- cadmium plated bodies and screen caps
- straight threads, machined faces and spark-plug-type gaskets on screen caps
- ten sizes from ¼" to 3"

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YARWAY STRAINERS

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GIVES GENTLE HANDLING THROUGH REPEATED PILING AND SPREADING

Pile formed by wiping material from tray above



Material leveled into uniform layer by stationary leveler

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from overseas felt that this was the most vivid and striking difference between the two industries.

Trade union membership is not very widespread in the American chemical industry; it is in Britain. Only 20 percent of U. S. chemical personnel are union members. But American employees—both organized and unorganized—welcomed the introduction of labor-saving machinery as a means of "taking the sweat out of the job." In Britain, the fear of unemployment is so strong that the unions look upon labor-saving devices as a threat to their security.

The U. S. excels in the use of instruments and automatic controls for chemical process work. The explanation—according to the visitors from abroad—may be the higher cost of labor in the U. S., the fact that these techniques have been used here for a long time in the petroleum industry and the emphasis in this country on continuous processes.

Only one U. S. plant indicated no interest in the merits of instrumentation and automatic controls. About 35 percent of the factories visited eagerly favored the use of full instrumentation and maximum automatic controls.

Nearly 60 percent of the plants favored instrumentation for recording purposes but preferred hand control so that the operator would really know his job.

In fact, one factory with automatic controls switches to full hand control for one hour a week so that employees will be prepared should an emergency situation arise.

The remaining plants—about 15 percent of those visited—appeared to favor wider use of instruments and automatic controls only where they had a clear-cut advantage.

GOVERNMENT AID

The visitors expressed admiration for the ruthless American policy of scrapping old and inefficient plants and equipment. Part of the explanation—according to our visitors—was the fact that the necessary materials for expansion and modernization were more easily available in this nation than elsewhere. But a big factor was the very considerable direct and indirect assistance that American industry receives from the government.

You can't stop a flood with a sieve



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CORROSION can't be stopped by ordinary paints or conventional protective coatings. They can't protect surfaces against the ravages of rust for any appreciable length of time.

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FIRST—Unlike maintenance paints, Bitumastic® Protective Coatings are specially formulated from a coal-tar pitch base* that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

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THIRD—Bitumastic Coatings stop corrosion caused by moisture — acid fumes—alkaline fumes—salt air—heat.

There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use the coupon for full information, or see our catalog in Sweet's Plant Engineering File.

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Last year the chemical industry spent $1,451 million . . .



. . . on new plants



. . . and equipment

In the next four years we will spend more millions . . .

. . . 1,364 in '53 . . . 1,309 in '54 . . . 1,228 in '55 . . . 1,350 in '56





Putting that in perspective, all other industry* looks this way

	Actual 1952†	Planned 1953	Preliminary Plans 1955	1956
Steel	1,538	1,246	623	785
Machinery	772	749	532	502
Electrical machinery	376	549	395	302
Automobiles	896	1,066	768	693
Transport equipment	253	309	56	37
Food	785	879	677	677
Petroleum, coal products	2,596	2,908	2,588	2,530
Textiles	400	396	305	281
Other manufacturing	2,927	2,634	1,817	1,817
ALL MANUFACTURING	11,994	12,100	8,989	8,974
Mining	880	1,003	682	692
Railroads	1,391	1,210	835	871
Electric, Gas utilities**	4,750	5,883	5,467	5,467
Other transportation, communication	2,961	3,139	2,741	2,456
ALL INDUSTRY	21,976	23,335	18,714	18,460

* Capital expenditures, millions of dollars
† U. S. Dept. of Commerce
** Electrical World, American Gas Association

No Depression Before '56 →

Here's McGraw-Hill's sixth annual survey of business plans for new plants and equipment





Capital Expenditure Survey

Businessmen plan to increase manufacturing capacity by 16 percent between now and 1956. By 1956, they also expect sales in manufacturing to increase by 10 percent. This is not a forecast but a statement of business plans and expectations based upon replies to the sixth annual McGraw-Hill survey of large business firms.

▶**Capacity Plans Still on Upgrade**—Industry plans to increase capacity in manufacturing by 7 percent in 1953, and then by another 9 percent by 1956. The biggest expansion in capacity, as shown in Table 1, is planned in the electrical machinery, transportation equipment, and chemical industries. Automobile and machinery makers expect to expand faster than the average of all industry over the long pull, 1953-56. The oil industry, long regarded as a pace-setter in business, plans to grow at about the average rate along with the rest of manufacturing. Food and other manufacturing companies plan modest, but still important, increases in capacity. The steel industry is definitely slowing down its rate of expansion.

A transition from defense to civilian production, beginning in 1953 and extending to 1956, is indicated by these capacity plans. Some of the defense-supporting industries, such as steel and non-ferrous metal producers, plan to complete large increases in capacity during 1953. But they do not plan to add very much more to

1. Manufacturing Capacity Is Increasing

Index of Industrial Capacity (1939 = 100)

	1946	1952	Planned for 1953	Planned for 1956
Steel	112	140	146	147
Machinery	154	304	331	371
Electrical Mach.	175	400	452	560
Automobiles	104	196	210	235
Transport Equip.*	243	423	503	553
Food	117	157	163	178
Chemicals	172	357	393	479
Petroleum Ref.	123	194	204	218
Other Mfg.	109	148	155	166
ALL MFG.	131	204	218	238

	Percent Increase 1951-2	1952-3	1953-4
Steel	8	4	1
Machinery	12	9	12
Electrical Mach.	13	13	24
Automobiles	15	7	12
Transport Equip.*	29	19	10
Food	3	4	9
Chemicals	11	10	22
Petroleum Ref.	5	5	7
Other Mfg.	5	5	7
ALL MFG.	9	7	9

* Including aircraft (all tables).



● A well-known varnish plant depends on this bank of Roper 3600 Series pumps to keep production humming. It is a typical example of Ropers on the job, for there are many similar installations. Some pump liquids even thicker than varnish; others pump liquids as thin as gasoline. The Roper 3600 Series is available in various combinations of pump sizes, gear reduction ratios, and motor sizes to provide unusual adaptability to innumerable pumping needs in petroleum, processing, and general industries. Capacities of 40, 50, 70, 90, and 100 g.p.m. at 60 lbs. p.s.i. are available.

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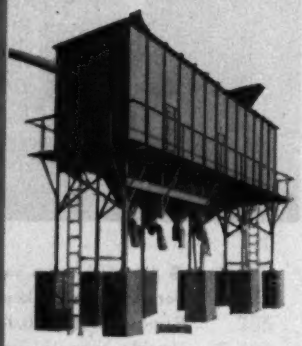








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their production potential by 1956. The durable consumer goods industries, such as automobile and electrical manufacturers, plan sizable increases in manufacturing capacity during the next four years. Consumer soft goods industries, such as food and apparel, expect to expand more slowly.

Plans for capacity are proving to be an unusually accurate indication of businessmen's thinking on their productive needs in relation to their markets. They make better estimates on their growth in capacity than they do about the actual dollar amount of capital spending. Table 2 shows how closely the actual level of capacity in 1952 turned out compared to plans for capacity which were made a year ago.

► **Growing Markets, Competition**—Businessmen feel there are larger markets ahead. This may be one of the reasons why industry continues to plan new capacity. Not only do businessmen expect larger markets, but individual firms plan to get a bigger share of the market for themselves.

Total manufacturing sales will increase about 10 percent, according to business expectations. At the same time, business managers plan to make the sales of their own firms grow by 13 percent. These are averages, of course, but down the line, company by company or industry by industry, the same tends to hold true.

Businessmen were asked how much they expected the sales of their company to grow by 1956. Then they were asked how much they expected industry sales to increase. When these replies were totalled, a sizable difference appeared between what each company planned to do in comparison with the industry.

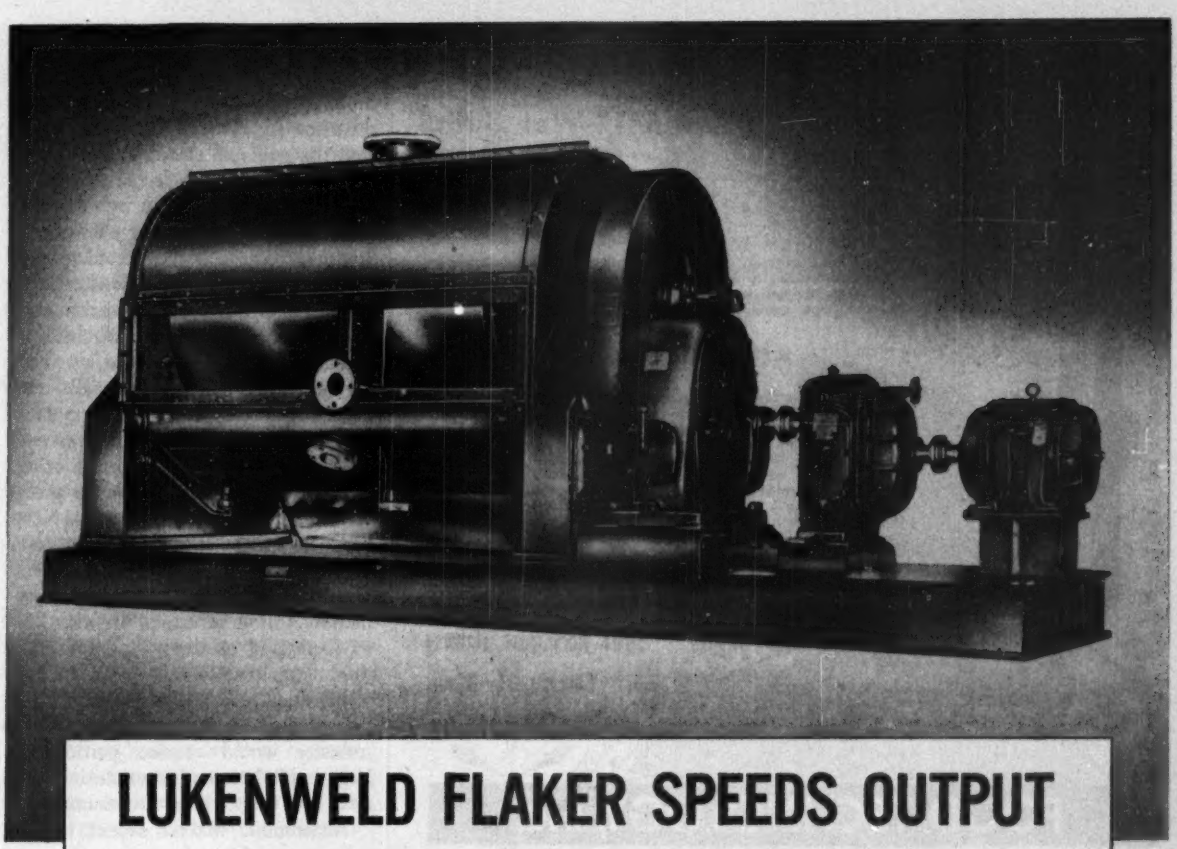
The greatest differences between company sales plans and expected industry sales were found in the auto-

2. Planned Capacity Compared With Actual

Index of Physical Capacity (1939 = 100)

	Planned 1952*	Actual 1952
Steel	141	140
Machinery	307	304
Electrical Mach	403	400
Automobiles	184	196
Transport Equip	438	423
Food	156	157
Chemicals	357	357
Petroleum, Coal Products	192	194
Other Mfg	149	148
ALL MFG	203	204

* As reported in January 1952.



LUKENWELD FLAKER SPEEDS OUTPUT FOR TENNESSEE PRODUCTS

In producing a new insecticide, the Tennessee Products & Chemical Corporation required high output . . . close temperature control . . . protection of product quality. A special Lukenweld flaking machine, employing the revolutionary features of Lukenweld jacketed steel rolls, met all three requirements at low cost and with savings in weight and power.

The high output and delicate temperature control made possible by the double-shell design of the Lukenweld roll results in rapid crystallization, fast flaking and high product quality. Quality is also protected by non-corrosive surfaces that contact the product before it is crystallized and scraped off by a doctor blade—the roll is chrome plated, the steam jacketed dip pan is nickel-clad steel, the agitators are solid nickel. And, because Lukenweld furnished the complete unit, it was installed as a single package, backed by a single source of responsibility.

If faster heating, cooling or flaking is your problem, Lukenweld jacketed rolls may be the answer. Built of rolled steel plate, they can be designed to operate safely at more than 350 psi. Use of plate permits a shell 40 to 75% *thinner* than ordinary rolls for faster heat flow, rapid heat up, quick shut down. With no heads to crack, no gaskets to blow out, you'll find Lukenweld design assures dependable long life, while better temperature control assures uniform product quality.

LUKENWELD

DIVISION OF LUKENS STEEL COMPANY

LUKENS

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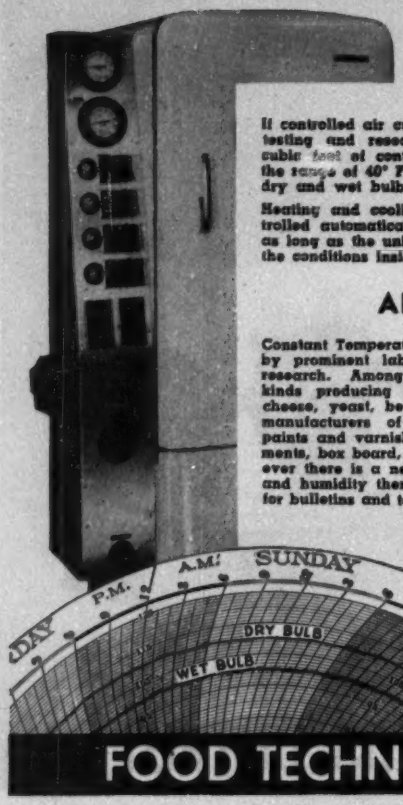
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Heating and cooling, humidifying and drying, are all controlled automatically and uniform conditions are maintained as long as the unit is in operation. Outside indicators reveal the conditions inside the box at all times.

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Constant Temperature and Humidity Cabinets are now in use by prominent laboratories in many lines for testing and research. Among the users are food manufacturers of all kinds producing bakery products, flour, packaged mixes, cheese, yeast, beer, candy and meat products; others are manufacturers of pharmaceuticals, photographic supplies, paints and varnishes, chemicals, insulating materials, instruments, box board, paper tape and crude oil products. Wherever there is a need for checking the action of temperatures and humidity there is a need for an Aire-Regulator. Write for bulletins and tell us your requirements.

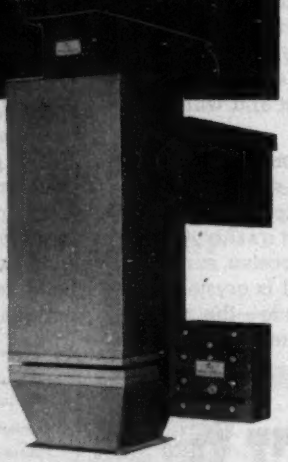
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Thayer Net-Weighing Scales handle weight units from 1 to 500 pounds at speeds up to 10 units per minute. Outstanding Thayer shockproof leverage system — without wear vulnerable knife edge pivots — guarantees continued accuracy. Stainless steel hopper and feeding system offer maximum protection against corrosive chemicals and contamination.

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The Thayer Scale — Where weight is worth money . . . it pays to be sure!

mobile, machinery, and chemical industries. By contrast, Table 3 shows that the steel and electrical machinery companies expect their sales to grow very closely with industry growth. Other lines where a strong element of competitive growth is expected by the company against the industry are these: Baking, breweries, cereal manufacture, engines, service machinery, special machinery, wool textiles, dyeing, knitting, building materials, cement, furniture, non-ferrous metals.

▶ **New Products and New Processes**— With stiffening competition looming ahead, new products and new processes assume great importance. New products are a powerful competitive means of bringing in new customers and capturing a bigger market. New manufacturing processes are the key to increasing efficiency and lowering production costs.

Manufacturers were asked what new products or new processes in their industry would require particularly large capital expenditures during the next few years. Here are examples:

Automobile makers expect to develop gas turbines for automotive engines. These will require a wholly new kind of parts. New high compression engines in the more immediate future will require better parts. Both of these developments will call for large capital spending.

Airlines will replace present piston engines with turbo-jet types. New jet aircraft will also be needed as additional equipment, not replacements for present fleets, within the next seven years.

Chemical companies say that coal hydrogenation may reach the stage where it will require large capital investment. More synthetic detergent plants, more petrochemical derivatives, and vertical integration of chemical companies are also planned.

Petroleum companies expect that

3. Expected Company Sales Increase Compared With Industry

	Expected for Company	Expected for Industry
Steel	3%	3%
Machinery	12	6
Electrical Mach.	22	22
Automobiles	29	19
Transport Equip.	−26	..
Food	14	10
Chemicals	28	21
Petroleum, Coal Products	17	14
Textiles	12	8
Other Mfg.	14	7
ALL MFG.	13	10

catalytic reforming to improve motor fuels will require large capital expenditure.

Coal companies foresee the need for more continuous coal mining machines.

Food manufacturers will increasingly use the high-temperature, short-time method of canning. This produces canned foods with more natural flavor and color at lower cost. Continuous bake ovens which use a steel conveyor band will find increasing use. With production of canned and baked goods being stepped up in these ways, pneumatic conveyors for handling bulk materials will be needed to keep up an adequate flow of materials. Higher speed filling and packaging equipment will also be necessary to keep pace with production.

Electronics manufacturers expect to continue investing in new equipment to produce larger picture tubes, color television, transistors, micro-wave application, and atomic energy power elements.

Machinery makers say their horizon includes larger forging presses, large injection molding presses, powder metallurgy, and more carboloy tipped tools.

Can makers are going in for tinless containers.

Lumber industry expects to make more low cost building panels from wood waste and to invest in electronic gluing equipment.

Railroads still have a way to go on dieselization and beyond that is Centralized Traffic Control.

Steel companies plan to expand the processing of taconite rock, a low grade iron ore.

Textile manufacturers say that drastic changes in spinning mills are coming in about five years and in looms in ten years.

Transportation equipment companies have large expectations for high pressure rubbber forming presses.

▶ **Expansion Versus Modernization**—A marked shift toward modernization

4. What Companies Plan to Spend For

(Expansion versus Modernization)

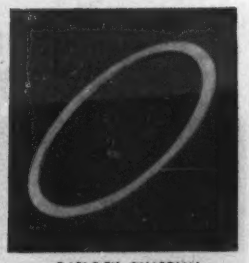
	1952		1953		1954-6	
	Exp	Mod	Exp	Mod	Exp	Mod
Steel	62%	38%	41%	59%	22%	78%
Machinery	55	45	50	50	52	48
Electrical Mach.	57	43	60	40	49	51
Automobiles	36	64	28	72	52	48
Transport Equip.	77	23	55	45	17	83
Food	28	72	45	55	17	83
Chemicals	76	24	71	29	67	33
Petroleum, Coal Products	42	58	40	60	39	61
Textiles	30	70	17	83	11	89
Other Mfg.	42	58	37	63	31	69
ALL MFG.	49	51	43	57	38	62



GARLOCK BITAN Leather Cups, Packings and Gaskets



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We're not trying to scare you, we only want to urge you to buy *enough* of the *right type* of extinguishers *in time* and have them *handy* wherever you have a fire hazard. Your local Pyrene* jobber has the right Pyrene equipment to cope with any fire hazard you may have—everything from hand extinguishers to automatic systems. He also carries Pyrene recharges. One call to him, one purchase order, one invoice will take care of any need you may have. Write us for his address. *T.M. Reg. U.S. Pat. Off.

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can be seen in the following percentages of total capital spending:

	Percent Spent on Expansion	Modernization
1951	58	42
1952	49	51
1953 planned	43	57
1954-56 (preliminary plans)	38	62

Table 3 indicates that industries in which total spending is declining are the ones which expect the largest portion of their funds to go toward modernization and replacement. The steel, transportation equipment, food, and textile industries show a strong tendency toward modernization.

▶**Planning Ahead**—Businessmen are not making definite capital expenditure plans as far ahead this year as they did in 1952. The majority of them still plan capital spending more than two years ahead (see *Table 5*), but a smaller-than-last-year portion of the companies say they have four or five year capital programs.

Although *formal* capital programs are not being formulated as far ahead, the number of firms able to give *preliminary* figures four years ahead, increased. This year, 81 percent of the firms gave preliminary investment figures four years ahead, compared with only 65 percent in 1952.

▶**Investment by Major Industries**—The amount of capital expenditures planned by business is still rising. This survey, consisting mainly of large business firms, indicates businessmen plan to spend $23.3 billion on new plant and equipment in 1953. This is a 6 percent increase over 1952. Manufacturing firms expect to invest about one percent more than last year, while gas and electric utilities, airlines, and mining plan higher increases.

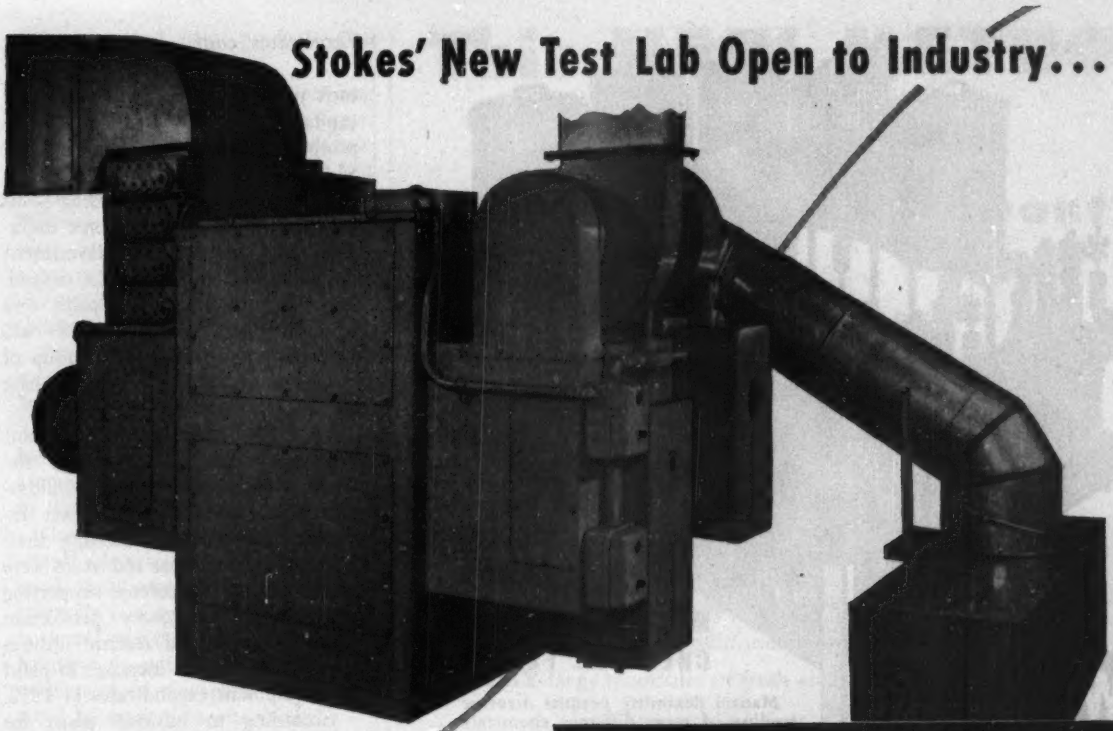
The outlook for 1954-56 shows business already projecting capital plans at a level well over $18 billion

5. How Far Ahead Capital Expenditures Planned

(Percent of Companies Answering)

	+5 yrs.	+4	+2	1 yr.
Steel	13	50	63	100
Machinery	0	9	50	100
Electrical Mach.	0	27	93	100
Automobiles	0	14	86	100
Transport Equip.	0	0	29	100
Food	0	18	64	100
Chemicals	0	15	75	100
Petroleum, Coal Products	0	21	79	100
Textiles	0	6	69	100
Other Mfg.	5	20	57	100
ALL MFG.	2	16	63	100
Mining	0	21	58	100
Air lines	0	50	100	100
Railroads	0	18	59	100

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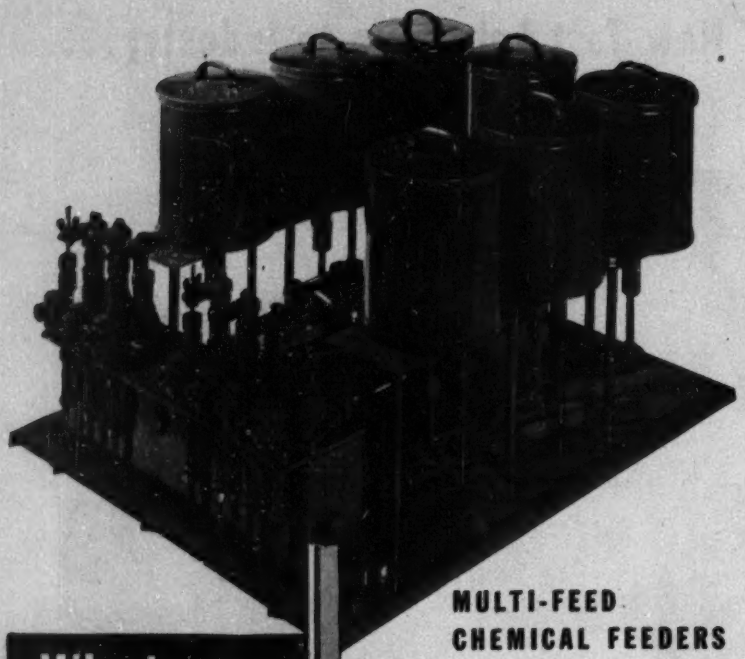
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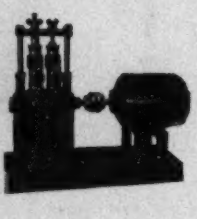
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each year. By comparison, industry's capital spending in the peacetime prosperity of 1947-50 ranged between $14 and $16 billion a year.

While total capital spending plans continue to rise in 1953, some industries are cutting their investment programs while others go on expanding. By and large, the plant and equipment expenditures in 1953 will be supported by as broad a group of industries as in 1952, but the base will be narrower than in 1951.

In 1951 business expanded plant and equipment sharply across the board, defense and consumer industries alike. During 1952, fewer industries continued to increase their investment, and these industries were mainly among the defense supporting group. Steel, machinery, petroleum, chemical, food, and electric utilities showed the greatest increases in plant and equipment expenditures in 1952.

According to business plans for 1953, steel, machinery, and chemical industries will decrease their capital expenditures somewhat. Food and petroleum will continue to increase their capital spending at about the same rates as last year. But the big increase in capital investment in 1953 will come in automobiles, electrical machinery, transportation equipment, mining, and utilities.

▶ **Investment by Product Lines**—The largest increases in capital investment programs by product lines (*see Table 6*) are found in agricultural machinery, office and store machinery, rubber and oil refining. Other groups, not shown in the table, which are making large increases in plant and equipment expenditures are airlines, gas utilities, shoes, furniture and engines. Among the food group, beverages, breweries,

6. Capital Spending by Product Lines

	More in '53 (vs. '52)	Less in '53 (vs. '52)
Agricultural Mach.	+62%	
Const. & Mining Mach.		−5%
Gen. Ind. Mach.		−28
Metalworking Mach.		− 6
Office, Store Mach.	+48	
Service Ind. Mach.		−15
Special Ind. Mach.		−26
Food Canning		−37
Paper		−25
Rubber	+10	
Glass		−12
Cement	+ 2	
Non-Ferrous Metals*		−27
Oil—Total	+12	
Production	+ 2	
Marketing	+22	
Refining	+49	
Transportation		− 7

* Mining and manufacturing.

distilleries, and dairy products plan bigger capital programs.

Products with less capital spending in 1953 than last year include paper, glass, non-ferrous metals, food canning, most lines of machinery, and rayon chemicals.

▶**Range of Investment, 1954-56**—How firm are these capital investment plans of business? Will they change sharply if business conditions change?

Business plans for capital investment are flexible, but there is more leeway for them to go upward than down. All manufacturing companies have preliminary plans to spend an average of about $9.3 billion a year in the period 1954-56.

Compared to this, the minimum annual expenditure they say they would make even *if sales declined substantially* is about $6.0 billion. In a business recession, therefore, manufacturers do not expect to cut their investment in new plant and equipment by more than one-third.

On the other hand, the maximum capital expenditure businessmen feel they could make in the period 1954-56, to take full advantage of all technological developments, amounts to about $13.8 billion. This is almost half again as high as the preliminary plans for expenditure during this period. Capital spending in 1954-56 would be well above the level of 1952-53 if businessmen spend the maximum amount which they feel they could usefully invest.

The biggest opportunities for increasing capital investment to take advantage of technical improvements are in the steel, machinery, food, chemical, petroleum, and textile industries. These industries have considerable latitude for modernization, judging from maximum spending businessmen report compared to their 1953 spending plans. (*See Table 7.*) By contrast, businessmen in the elec-

7. Capital Spending Under Changing Business

(Millions of Dollars)

	Planned 1953	Average 1954-56 Spending Minimum	Maximum
Steel	1,246	473	1,396
Machinery	749	389	951
Electrical Mach.	549	170	472
Automobiles	1,066	320	853
Transport Equip.	309	49	216
Food	879	440	1,011
Chemicals	1,364	641	1,760
Products	2,908	1,745	2,995
Textiles	396	182	499
Other Mfg.	2,634	1,633	3,688
ALL MFG.	12,100	6,042	13,841

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- ▶ to increase your air conditioning capacity
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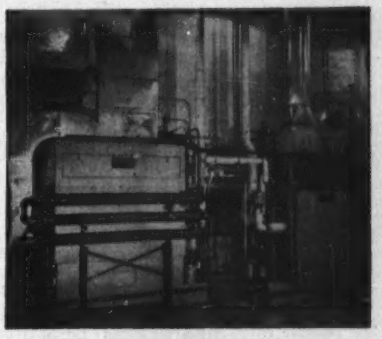
Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

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Most compact, taking less space for installation.

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The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.



Niagara Controlled Humidity Air Conditioning

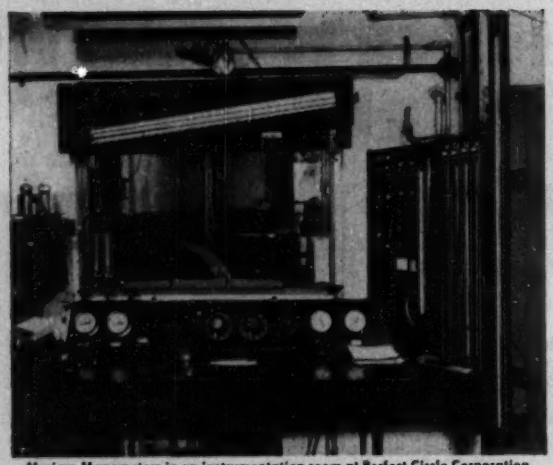
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trical machinery, automobile, and transport equipment industries do not think that the maximum level of investment which they could profitably make for technical improvements in the future would equal 1953 spending.

▶ **Depreciation**—The most important thing about depreciation funds is that they are increasing. Depreciation in manufacturing will increase from $5.9 billion in 1952 to $7.8 billion in 1956, according to businessmen's reports.

Today depreciation finances a little more than half of the capital spending. Depreciation in 1953 will amount to $6.8 billion in manufacturing, as shown in Table 8, compared with $12.1 billion planned for new plant and equipment.

About 85 percent of the manufacturing firms report that they have a policy of spending all their depreciation allowances for plant and equipment and that they expect to continue that policy. Another 5 percent have been spending all their depreciation for capital goods but plan to change this policy. Presumably they feel the need to build their working capital position or pay off debt. The remaining 10 percent of the manufacturers have not spent all of their depreciation for plant and equipment, nor do they intend to in the future.

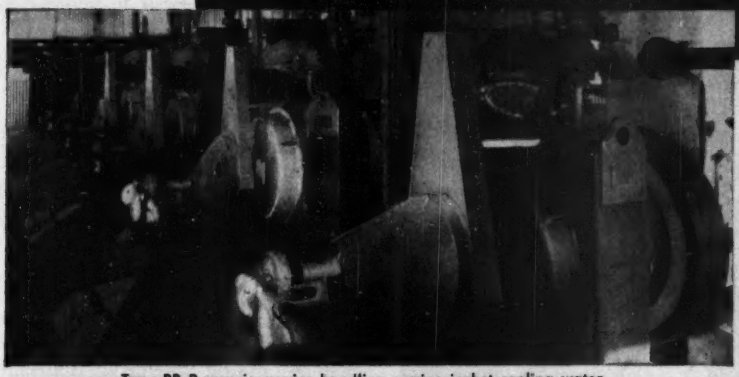
Depreciation reserves appear to hold up the minimum level of capital spending which businessmen say they would make even under recession conditions. The minimum capital spending businessmen report for 1954-56 is $6.0 billion a year while depreciation funds will average $7.5 billion in this period. About 80 percent of depreciation funds will go into plant and equipment even under adverse conditions.

We can also get some inkling of where future capital spending will be strongest from the accumulation of depreciation funds. Table 8 shows that depreciation funds are now a fairly small proportion of present capital spending in the basic industries. The ratio of depreciation to spending is between one-third and one-half in steel, machinery, electrical machinery, automobiles, chemicals, and petroleum. It is only about one-sixth in transport equipment.

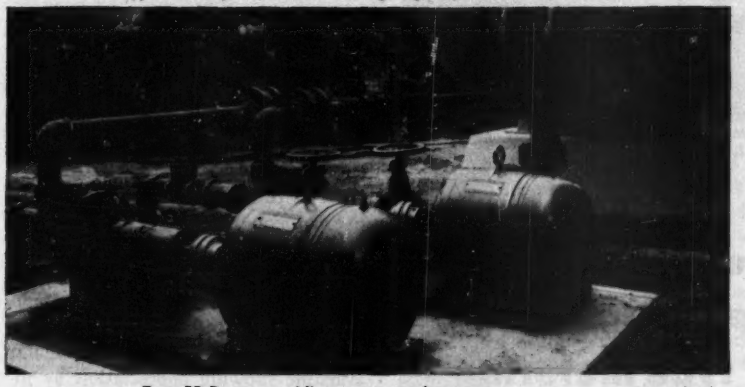
But the dollar amount of depreciation is also growing the most rapidly in these same industries. This comes

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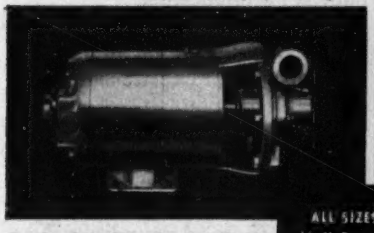
PEERLESS PUMPS



Type PB Pumps in service handling engine jacket cooling water.

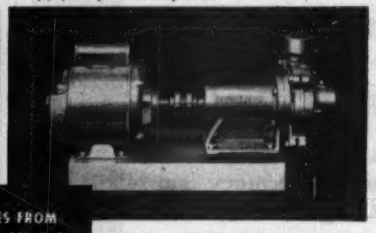


Type PB Pumps providing water supply to pressure system.

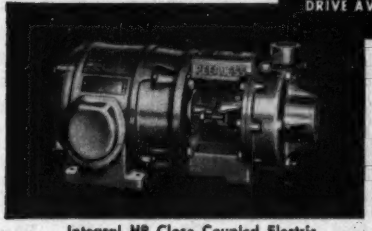


Fractional HP Close Coupled Electric Type PE Fluidyne Pump

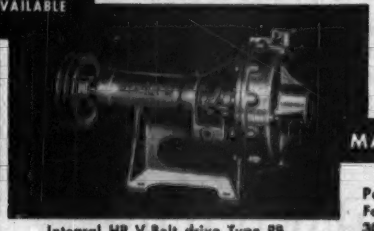
ALL SIZES FROM ¼ H. P. to 150 H. P. ALL TYPES OF DRIVE AVAILABLE



Fractional HP Flexible Coupled Type PB Fluidyne Pump



Integral HP Close Coupled Electric Type PE Fluidyne Pump

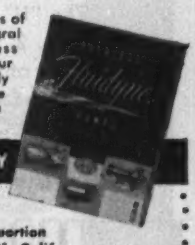


Integral HP V-Belt drive Type PB Fluidyne Pump

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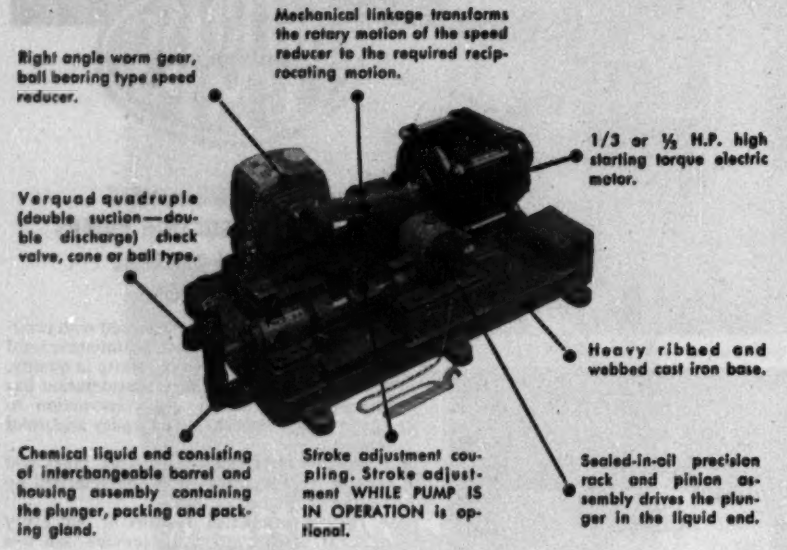
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about from the large investment in defense facilities needed in these industries since 1950, plus the rapid amortization of defense plants which the government allowed. The basic industries will, therefore, have large sums from depreciation becoming available in 1954-56. In steel the depreciation reserves may pile up faster than is needed to finance planned capital investment. By 1955 for instance the steel companies will have $829 million in depreciation, but their preliminary investment plans amount to only $623 million. Somewhat the same situation is true in transport equipment, engines, apparel, meat, and non-ferrous metals.

The manufacturers of consumer goods, on the other hand, already have a fairly high ratio of depreciation to spending, and their depreciation funds are not increasing rapidly. This is true of food, textiles, and the "other manufacturing" group, which includes apparel, paper, lumber, rubber, etc. Almost two-thirds of capital spending is financed out of depreciation in these industries. Growth in depreciation allowances will be very modest by 1955 in these industries because they did not benefit from the defense expansion or the rapid amortization provisions.

Table 8 contains the first figures available showing depreciation by industries for future years.

▶**How This Survey Was Made**—The capital expenditure survey made by the McGraw-Hill Department of Economics is a report on the plans of industry for 1953 through 1956. It does not tell what ought to be spent for new plant and equipment. It is not a commentary on the policy implications of capital expenditure plans. It is solely a report of what industry now intends to spend on capital goods.

The companies cooperating in this survey employ more than 60 percent

8. Depreciation Funds by Industry

(millions of dollars)

	Actual 1952	Expected 1953	Expected 1955	Expected 1956
Steel	538	769	829	818
Machinery	371	430	460	460
Electrical Mach.	169	199	237	237
Automobiles	358	476	505	530
Transport Equip.	53	70	76	76
Food	495	510	569	594
Chemicals	638	759	912	970
Petroleum, Coal Products	1,116	1,261	1,462	1,551
Textiles	244	256	278	281
Other Mfg.	1,903	2,074	2,207	2,246
ALL MFG.	5,885	6,804	7,535	7,763

of all workers in industries where capital investment is highest. That includes chemicals, oil, railroads, machinery, autos, utilities, and steel. These industries account for two-thirds of all spending for capital goods. The companies included in the sample were mostly the bigger companies in these industries.

In other industries, coverage was not so complete. But the participating companies were carefully picked to make up a representative cross section.

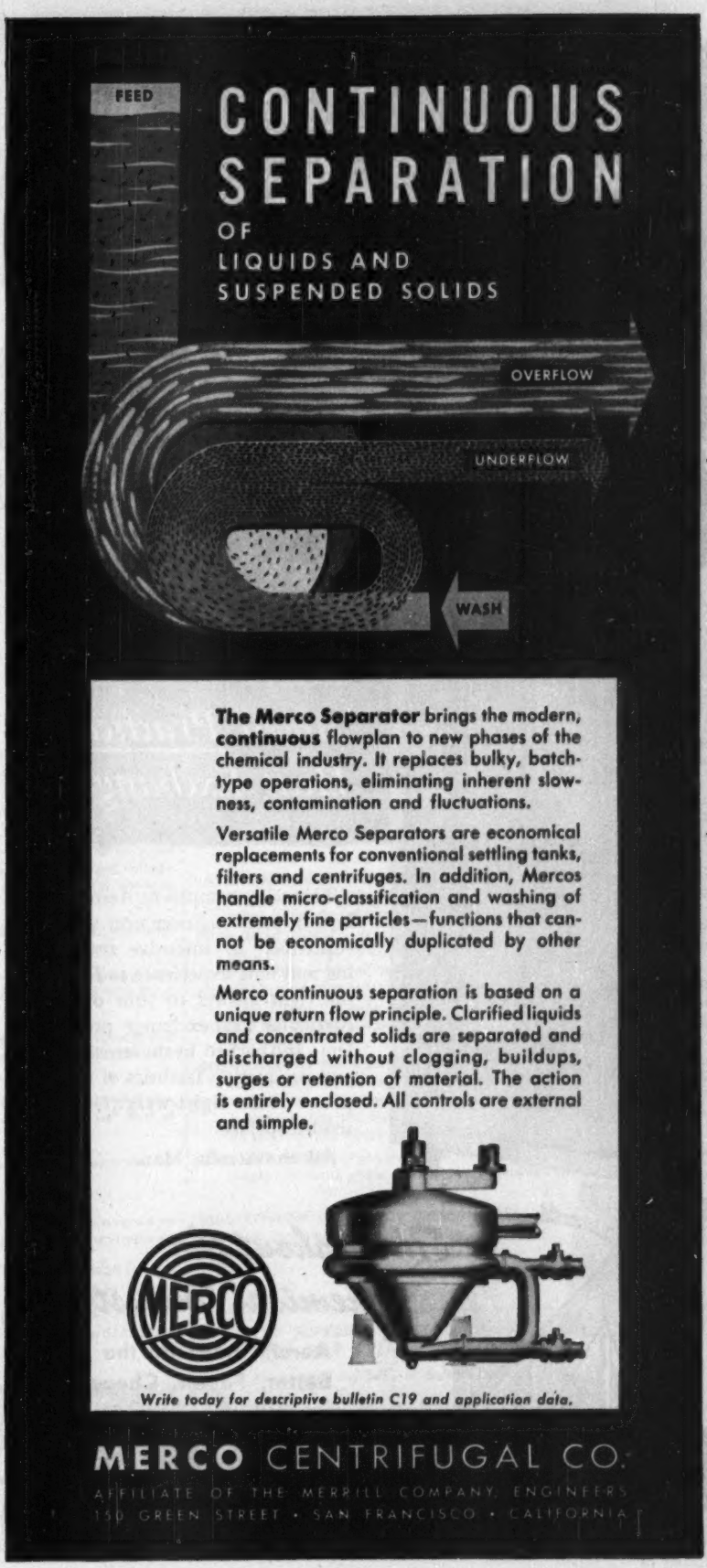
In all, the sample includes companies employing over five million workers. That is about one-quarter of the total employment of all industry.

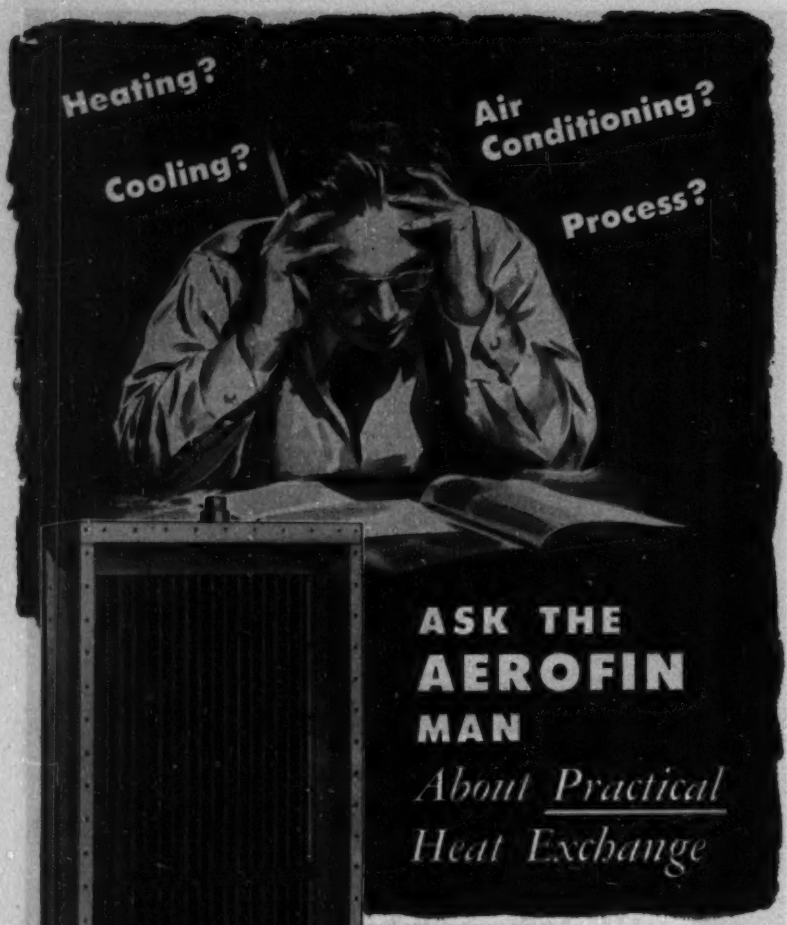
Physical capacity was measured by figures supplied by the cooperating companies themselves. All companies were asked to select their own measures of physical output. A steel company may use ingot tons, for example, while an aircraft engine maker compares the rated horsepower of the engine he produces. The results are the only available direct measures of the expansion in industry since 1939.

The capacity index in this report is the most widely used capacity information available, and this year's capacity figures are directly comparable with those published in last year's McGraw-Hill report. The dollar figures on capital expenditures used in this report, on the other hand, have been put on the same basis as the revised series published by the Department of Commerce for the years 1945-52. To make comparisons with the dollar amount of capital investment in past years, therefore, the Department of Commerce series should be used.

The McGraw-Hill study makes no allowances for the change in the value of the dollar. The totals reported by industry are compiled exactly as they are given. Therefore, to obtain the actual physical difference between one year's spending and another's, you must remember that the value of money has shrunk.

Capital spending for the electric utility companies was obtained through the cooperation of *Electrical World*, a McGraw-Hill publication. Figures on gas utilities are from the American Gas Association Survey. Correspondents of *Business Week* personally interviewed many company executives. Other McGraw-Hill magazines helped in conducting the survey in their own particular fields.



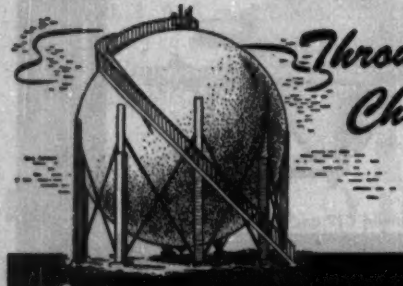


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INVESTMENTS

. . . Oil or Chemicals?

"If you want to invest for a retirement income, put your money in oil." This is the advice of Mott Souders, Jr., associate director of Shell Development Co. and a well-known authority on investments and the flow of money.

Speaking at a meeting of the Northern California Section of AIChE, Souders analyzed three of our biggest growth industries: chemicals, petroleum and electrical utilities. Here are his conclusions.

Based on the Federal Reserve Board index of physical production, electric utilities have had an average yearly growth of 9 percent during the past 15 years, chemicals 8 percent and petroleum only 5 percent. From this it appears that utilities provide the best investment opportunities; but the fate of $100 invested in representative stocks at the 1936 high in each of the industries proves otherwise.

Souders picked 12 oil, 10 chemical and 7 electrical utility companies* for his analysis. One hundred dollars invested in the 12 oil companies would now be worth $201, with an additional $64 having been paid out in dividends; the chemical stock would now be worth $155, plus $52 in dividends; the utilities stock would now be worth only $90, plus $68 in accumulated dividends.

Apparently, growth companies in a growth industry are not sufficient criteria in the selection of a growth stock. Although the electric utility industry has a steeper growth curve than either chemicals or petroleum, the utilities have not been good growth investments for the stockholder.

Low rates of earnings and high dividend payouts have prevented substantial growth in the utility stockholder's equity. There has been no compounding of yield from earnings retained in the business. Consequently, growth has been based on borrowed money and preferred stock. The high yields and retained earnings in both the

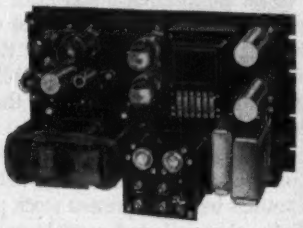
*CHEMICAL COMPANIES: Air Reduction, Allied Chemical & Dye, American Cyanamide, Commercial Solvents, Dow, Du Pont, Hercules, Mathieson, Monsanto, Union Carbide; PETROLEUM COMPANIES: Atlantic, Cities Service, Gulf, Lion Oil, Ohio Oil, Phillips Petroleum, Shell Oil, Socony-Vacuum, Stand. of Calif., Stand. of Ind., Stand. of N. J., Texas Co.

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WIDE INPUT RANGE — is another important feature. Range is 95-135 volts for a nominally 115 volt unit; 195-255 volts for a 230 volt unit; 400-520 volts for the 460 volt units.

ADJUSTABLE OUTPUT VOLTAGE — Output from a 115 volt unit is adjustable from 110 to 120 volts; output from a 230 volt unit is adjustable from 220 to 240 volts; output from a 460 volt unit is adjustable from 420 to 460 volts.

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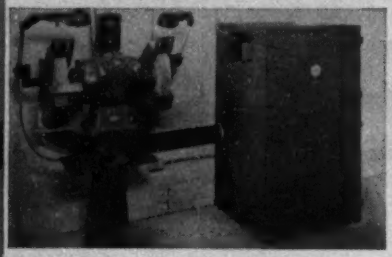
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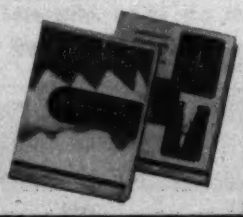
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chemical and oil industries, on the other hand, have made such compounding possible.

Although the rate of return on capital is higher for chemicals than it is for oil (13.4 percent of net worth vs. 10.3 percent), over the past 15 years stockholders in petroleum companies fared better than those in chemical companies. What, then, is a decisive factor in the selection of a growth stock?

A clue can be found in the dollars of capital assets per dollar of investment at today's stock market level. A dollar invested in petroleum will buy about $0.90 worth of assets; a dollar invested in chemicals will buy only about $0.40 worth of assets.

This means that an investor in oil stocks buys assets at nearly book value, but in the chemical industry the investor pays a premium of 200-300 percent for the assets he shares through his stock investment.

"What really concerns the investor today is probable future growth and earnings based on present stock prices. Both chemical and petroleum companies have more opportunities for investment than they have money to invest. We would be safe in assuming, then, that their next 15 years should reflect their past 15 as closely as anything can in this uncertain world."

The value to the investor of the earnings of any company has two parts: (1) the dividends paid which he can reinvest in more stock, and (2) the earnings retained by the company and reinvested in the business. The ideal growth stock is one in which the value of assets is appraised low on the stock exchange, in which the return on invested capital is high and in which little of the earnings is paid out as dividends. The compound interest formulas show that retained earnings is the most important factor.

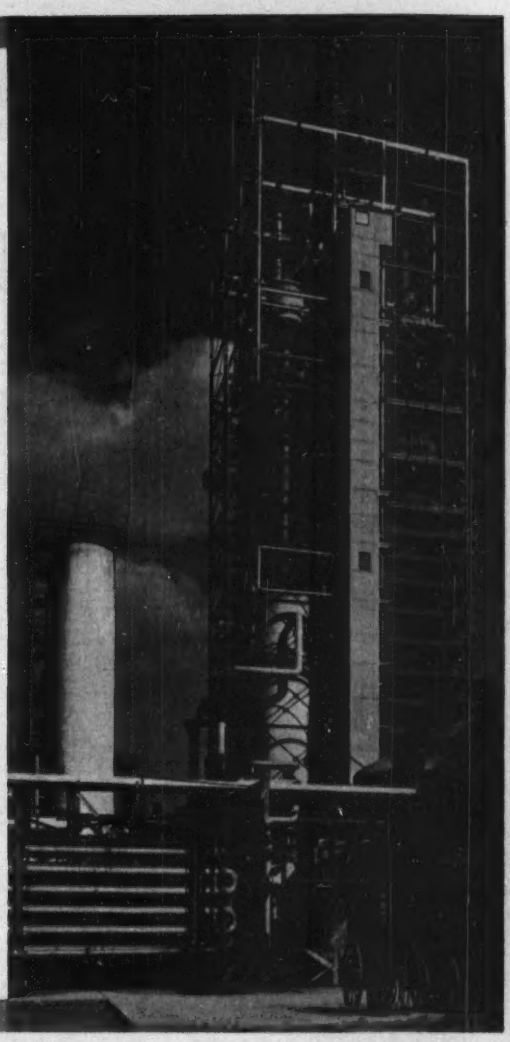
"Taking all factors into account, the stockholder in oil companies has a growth potential that is one and four-fifths as much as the stockholder in the chemical companies."

Oil vs. Chemicals—Est. 15-Yr. Growth
Basis: dollars per $ of current stock price

	Oil	Chemicals
Dividends compounded at	8.0%	4.4%
Retained earnings compounded at	10.3%	13.4%
Growth from dividends	$ 0.74	$ 0.49
Growth from retained earnings	$ 1.72	$ 0.92
Total growth	$ 2.46	$ 1.41

Forty billion barrels ago—





Measured in years, it is less than a century since Colonel Drake drilled the first oil well, in 1859. Measured in terms of the gigantic American petroleum industry which grew from his pioneering enterprise, the August day when his well spurted forth the long-sought oil was more than forty billion barrels ago.

Two thousand barrels was the output in 1859. About two billion barrels now come yearly from American wells to meet the demands of the modern motor and the varied other uses of petroleum products.

For decades, Sun Ship has played an important part in construction of the refinery equipment . . . fractionating towers, condensers, pressure vessels, machinery and other equipment . . . to meet these demands. The facilities, modern manufacturing methods and skilled personnel at the great Sun Ship plant provide a combination that has consistently shown its ability to serve the petroleum, chemical and petrochemical industries in the task of building a greater America.

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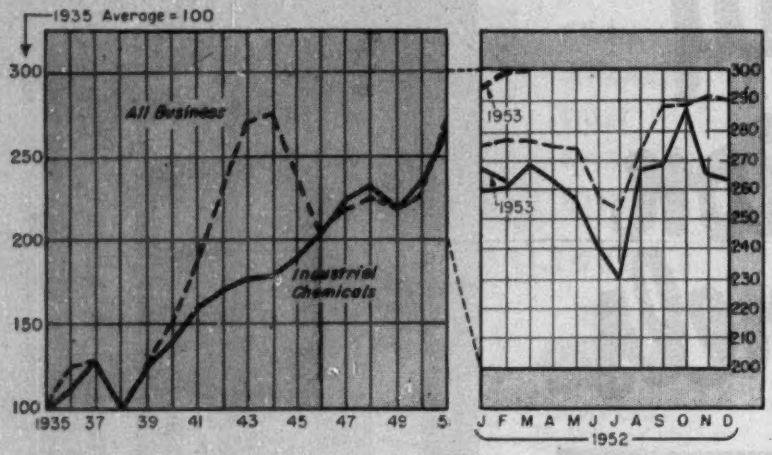
ON THE DELAWARE SINCE 1916 **CHESTER, PA.**

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Process Industry Trends

Douglas Greenwald, McGraw-Hill Dept. of Economics

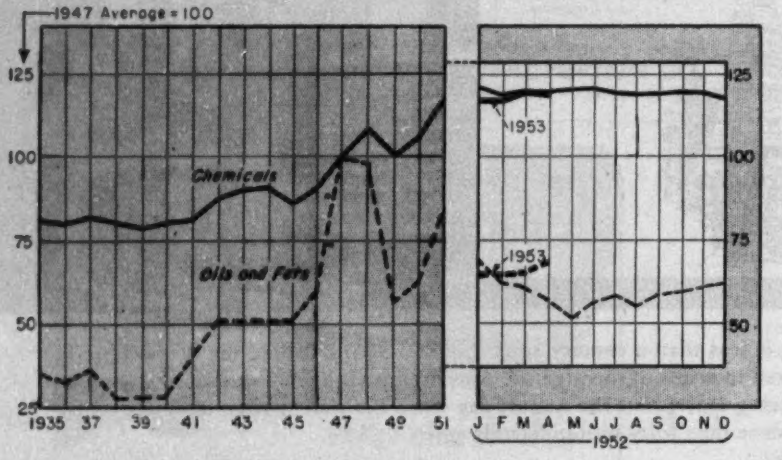
CONSUMPTION



Industrial Chemicals Index

	February (Est.)	January (Prelim.)	December (Revised)
INDEX	264.00	268.29	264.65
Fertilizer		58.35	56.43
Pulp and paper	29.90	28.34	28.45
Petroleum refining	25.52	28.40	27.99
Iron and steel	16.38	18.14	17.77
Rayon	25.95	29.86	30.03
Glass		21.68	19.54
Paint and varnish		22.00	22.50
Textiles		10.00	10.36
Coal products		12.15	11.61
Leather		4.45	4.25
Explosives		8.16	8.21
Rubber	6.38	6.84	6.56
Plastics		19.92	20.95

PRICES

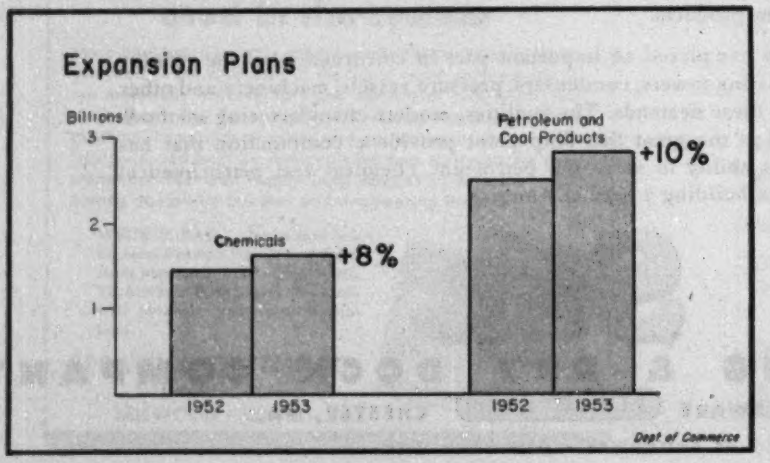


Chemical Engineering's Price Indexes

Chemicals DOWN -0.8%
Oils and Fats UP +7.0%

	Chemicals	Oils & Fats
As of March 1, 1953	118.10	68.17
Last month	119.07	63.71
April 1, 1952	120.04	56.14
April 1, 1951	118.98	96.90

HIGHLIGHT OF THE MONTH



Another Estimate of Capital Spending

Capital spending by manufacturers of chemicals and petroleum and coal products is heading up again in 1953. This is revealed by a Department of Commerce survey of manufacturers' plans. The results are somewhat different from the report made by the McGraw-Hill Department of Economics. (See page 358.)

Commerce expects a 9 percent increase in the total capital spending of these two industries with a 10 percent gain in petroleum and coal and an 8 percent increase for the chemical industry.

New BROCHURE!

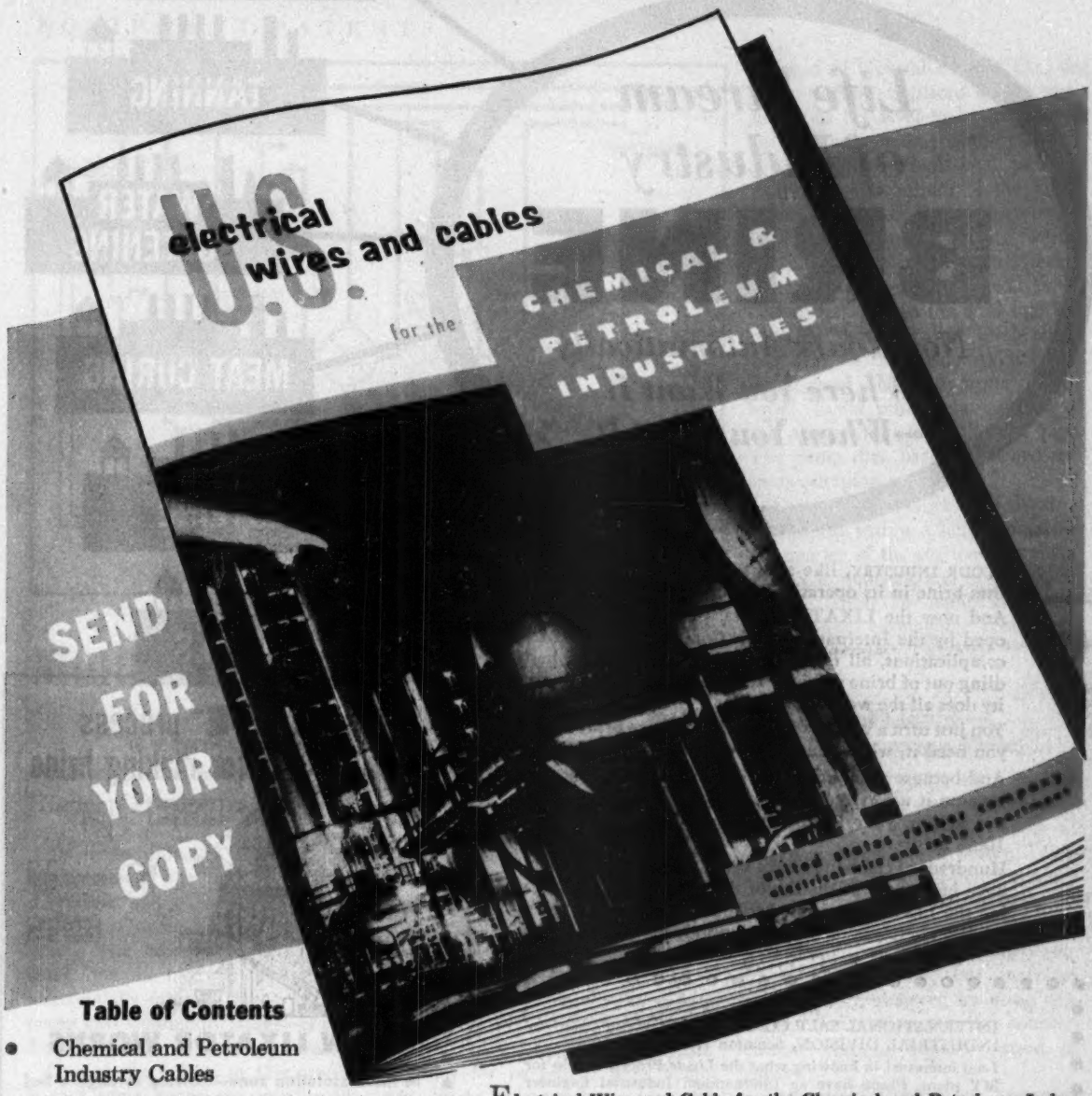


Table of Contents

- Chemical and Petroleum Industry Cables
- Insulation Compounds
- Jacket Compounds
- Portable Cables
- Power Cables
- Control Cables
- Telephone Cables
- Tables

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The brochure shown above shows what "U.S." wires and cables to order for specific applications. Write to address below for your free copy.

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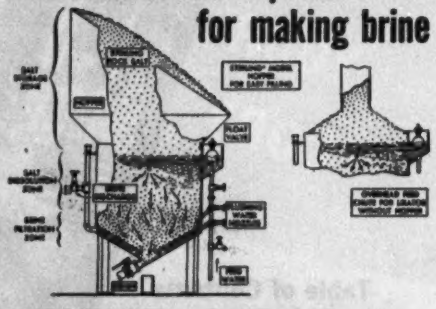
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the LIXATE* process for making brine



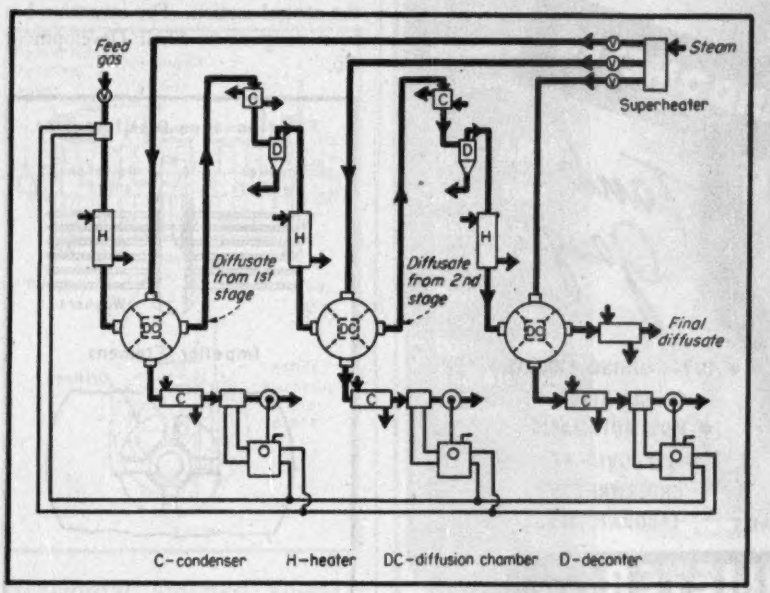
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EQUIPMENT PATENTS



Multi-stage Sweep Diffusion

New process uses preheaters and condensers before each stage to keep sweep gas from diluting the feed gas. Higher diffusion rates are attained.

In sweep diffusion processes, feed gas passes on one side of a porous diaphragm and a condensable vapor passes as a "sweep medium" along the other. The component being separated from the feed gas then diffuses preferentially into the sweep gas, the sweep gas—commonly steam—is condensed, and the diffusate removed.

One of the defects in this process is that some sweep gas usually diffuses across the diaphragm into the feed gas, thereby diluting it and reducing the rate of diffusion.

In Earl V. Harlow's new method, the back-diffused sweep gas is removed between successive stages by condensation from the feed gas (see cut).

The feed gas is then preheated before going to the next stage. This prevents condensation of steam on the other side of the diaphragm in the next stage. The ratio of flow of fresh gas to diffusate gas free of steam is controlled at a fixed proportion.

In the process described, the diffusate gas is not recycled to an adjacent stage for further purification, as is normally the case. The reason is not explained in the patent, but it appears that it's because the process is intended to be used for removing most of the hydrogen from fuel gases, and not for recovering pure hydrogen. Since hydrogen has a high diffusion rate, the separation is relatively simple.

The invention, U. S. 2,626,679, has been assigned to Koppers Co., Inc.

Liquid Level Control in Gas Absorbers

A constant liquid level can be maintained at the bottom of a gas absorber by using a self-regulating centrifugal pump described in U. S. 2,627,366.

In this patent by Sylvan G. Glick, assigned to General Electric Co., the pump suction is placed at the same height as the level to be maintained in the tower, and is connected by a short length of horizontal pipe directly into the bottom of the tower. When the liquid level drops enough to admit gas to the pump section, the pump loses its prime and immediately stops pumping liquid.

A check valve in the discharge line prevents the return of liquid from this line to the pump. When the liquid level builds up again in the tower, liquid pushes the gas out of the pump through a tall vent pipe. The pump then becomes primed and starts pumping again.

According to Glick, the level is maintained within a height of about one-quarter of the suction pipe diameter. The pumping and non-pumping periods repeat in rapid succession, each period averaging about one second.

Centrifugal Liquid—Liquid Contacting Plate

In U. S. 2,619,280, Otto Redlich has come up with one of those ideas which make us all wonder "why no one ever thought of it before." It is an apparatus for liquid-liquid contacting operations, such as extraction, at high throughput rates.

Basically, it is like an ordinary perforated plate tower, but increased throughput is achieved by using centrifugal force to create the countercurrent flow of liquids, instead of gravity.

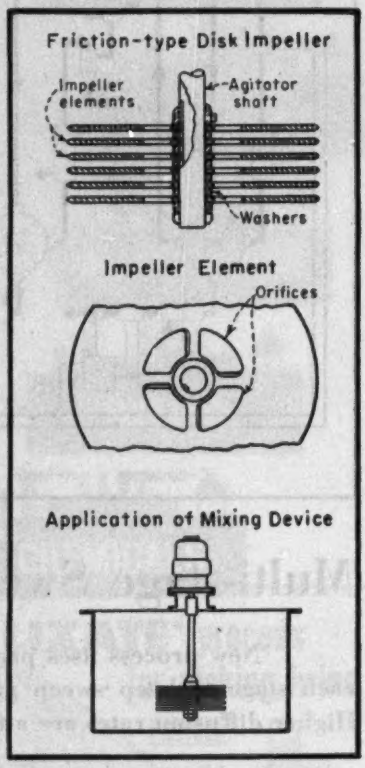
Perforated cylinders are mounted concentrically on a rotating shaft. The liquid having the lower density is fed in at the outer part and the heavy liquid at the inner part of the apparatus. Centrifugal force then causes a centrifuging effect, creating countercurrent flow of the liquids.

The heavy liquid moves through the perforated cylinders and is distributed as droplets in the light liquid. Disengaging spaces are provided between adjacent cylinders to allow continuous accumulation of the heavy liquid phases "beneath" each cylinder.

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Flow of the light liquid is cross-wise across the "upper" surface of each cylinder, and the analogue of down-pipes is provided for the flow of light liquid from cylinder to cylinder toward the central section. The invention has been assigned to Shell Development Co.



Mixing with Disk Impellers

An agitator claimed to be capable of functioning effectively in liquids of any viscosity, and even in semi-solids, is described in U. S. 2,626,135, by Herbert E. Serner.

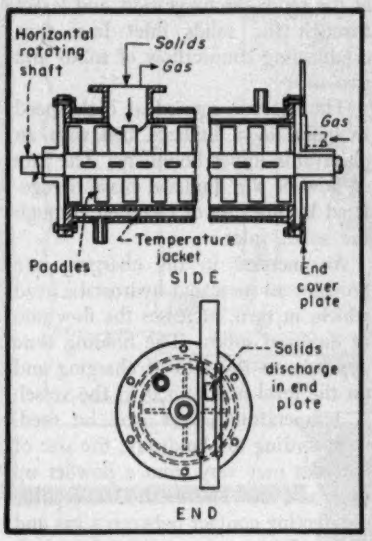
A set of identical equal-diameter impeller elements in the form of flat rings or annuli is used (see cut). These rings contain central "orifices" of identical size and shape, and are assembled concentrically on the agitator shaft, rotating as a unit. The rings are spaced apart by washers.

The capacity of the device can be altered by reducing or increasing the number of impeller elements, or by changing their spacing by varying the number of washers.

In operation, fluid enters axially through the central openings formed by the orifices. As it enters the space between two adjacent elements, the flow becomes radial in a helical path,

and is accelerated by the surface friction of the impeller elements.

It is claimed that the creation of a large number of "shear-planes" within the fluid produces a non-uniform motion that gives exceptionally thorough mixing.



Horizontal Agitated Vessel for Gas-Solid Contacting

In many processes involving the contacting of solid particles with a gas, the problem of effecting intimate contact has been solved by utilizing a fluidized bed technique. In large beds, however, there is a tendency for the bed to channel and for the gas to accumulate as a bubble, both of which prevent effective contact.

Another difficulty is short-circuiting of the solid from the top to the bottom of the bed when the solid is caused to flow continuously. Furthermore, fluidized bed operation is impaired by any agglomeration of the solid particles due to sintering.

In U. S. 2,627,668, Erwin C. Handwerk discloses a method of maintaining a fluidized bed in a mechanically agitated horizontal reactor.

The solid particles enter continuously at one end and leave at the other. Handwerk claims that the difficulties mentioned above are avoided by this new technique which has been assigned to the New Jersey Zinc Co.

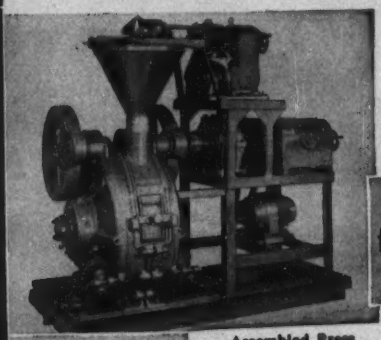
One modification of the apparatus is shown above. A horizontal rotating shaft, fitted with paddle blades, runs through the vessel, providing the necessary agitation of the solid particles in the gas. The solids outlet is a

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For quick reference see "Sweet's 1952 Processing Industries" or "Chemical Engineering Catalog, 1953."

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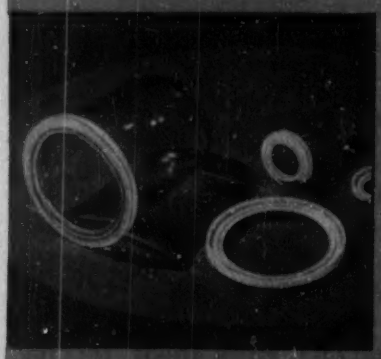
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vertical slot in the end plate, at the end opposite to the inlet.

The level of solids is regulated by the position of the opening in the cover plate of this discharge opening. Gas is fed through a separate opening at the solids discharge side, and leaves through the solids inlet line, thus establishing counterflow of solids and gas.

The shaft is rotated at high speed to maintain a fluidized bed with an observable upper boundary. The rate of flow of the fluidized mass is regulated by the rate of charging through the solids inlet.

An increase in the charging rate provides an increased hydrostatic head which, in turn, increases the flow rate of fluidized solids. The holding time depends on the rate of charging and on the level maintained in the vessel. A temperature jacket may be used.

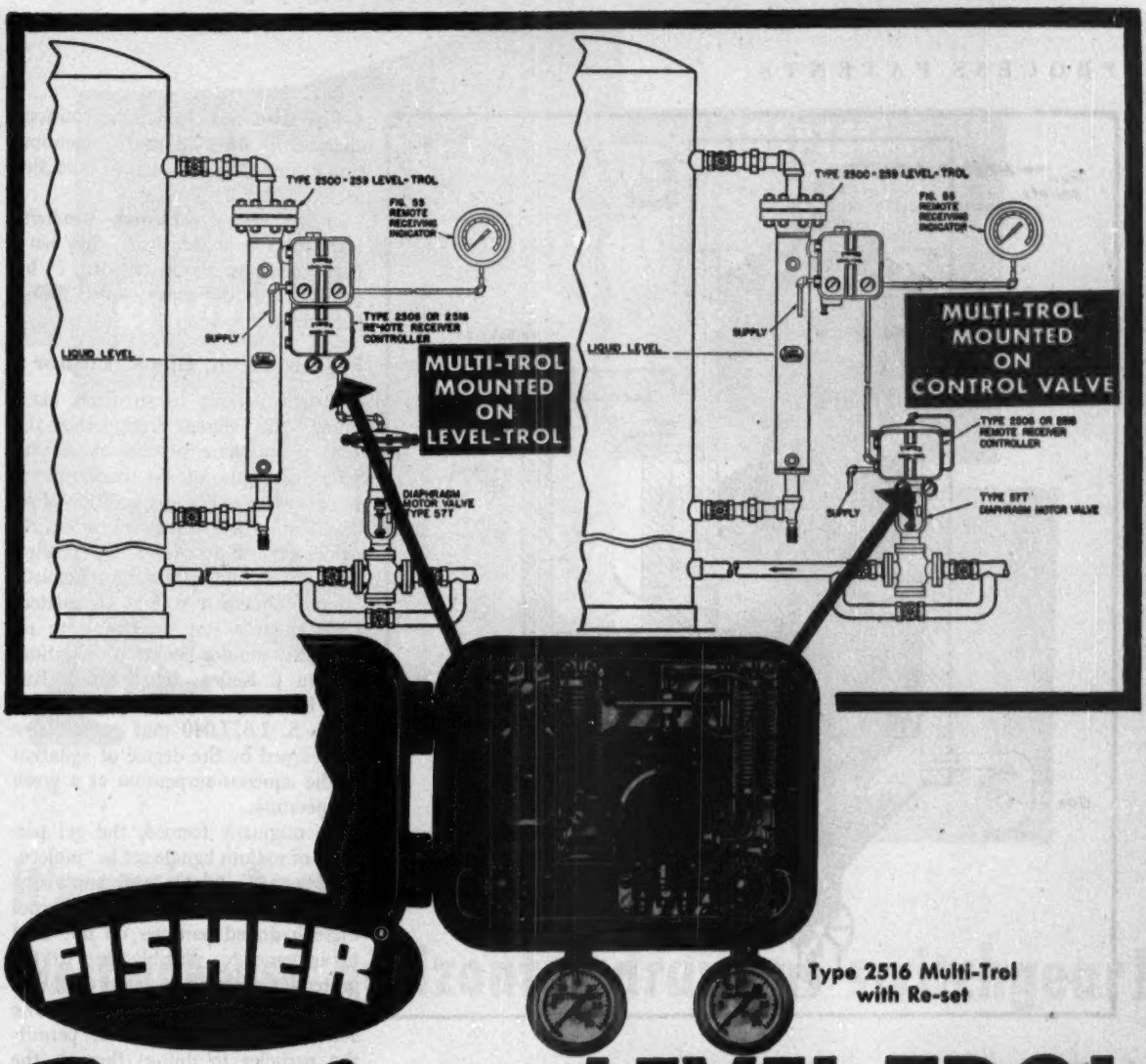
According to Handwerk, the size of particles may vary from a powder up to ¼ or ¾ in. The method is capable of effecting contact between a gas and such solids as zinc oxide, fine coal, zinc sulfide ore concentrate, crushed limestone and crushed iron-titanium ore such as ilmenite. The gases may be either inert (such as a heating gas) or chemically reactive (such as air and steam for the manufacture of producer gas from anthracite coal). Examples are given in the patent of some of these applications.

It is claimed that the paddle structure is not critical, but that flat blades are generally preferred. They can be either parallel to the axis of the shaft or slightly pitched. The shaft can be hollow to aid in heat transfer.

Peripheral speeds of 150-450 ft. per min. are used, with rotational speeds varying from 20 to 150 rpm. depending on the diameter of the vessel.

For Keeping Posted . . .

This digest of recently issued patents is selected and evaluated for you by Melvin Nord, 664 Putnam, Detroit 2, Mich. You can get copies of any patents, including those mentioned here, by ordering from the Commissioner of Patents, Washington 25, D. C. They cost 25¢ each. Do not send stamps.



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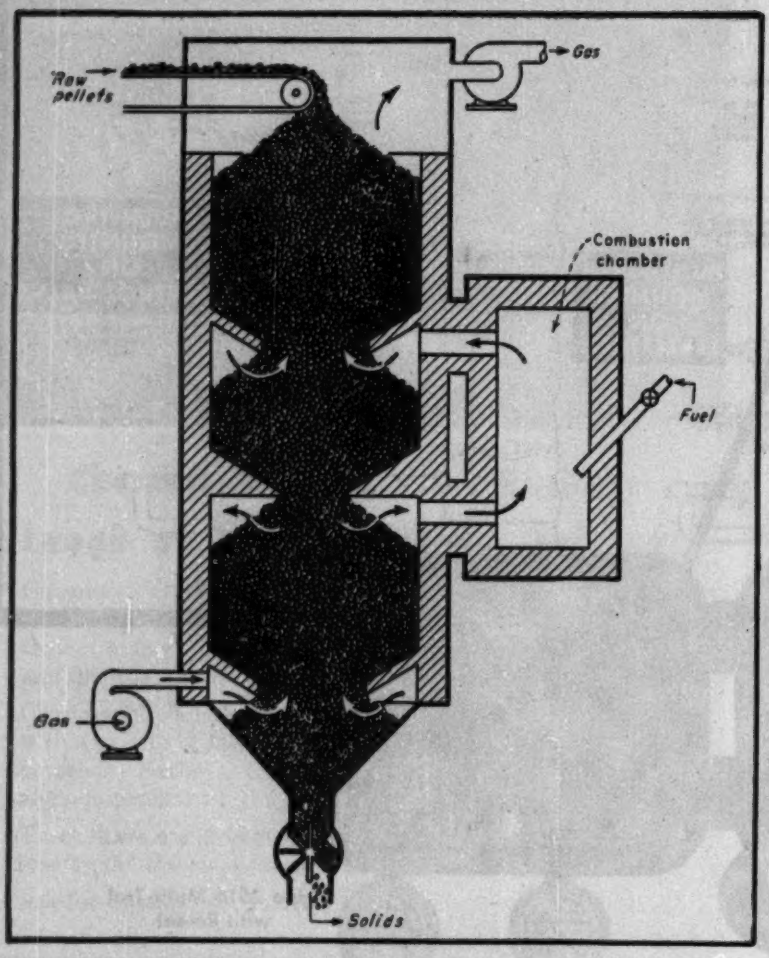
5—Pilot may be changed from a direct acting to a reverse acting unit or vice versa, thru the use of switch plates.

6—Pilot may also be changed from proportional action to two position action or vice versa, by repositioning a switch plate.

Write for Bulletin F-2506

FISHER GOVERNOR COMPANY, Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL



New Portland Cement Process

Here's a way to make Portland cement that does away with the high exit temperatures normally encountered. Close particle contact is also provided.

Portland cement can now be made continuously at a temperature below the sintering point, and with improved thermal economy. The process is described in U. S. 2,627,399 (see cut).

The raw materials are first formed into pellets of ¾-1¼ in. diameter by balling-up with water. They are rolled together at a pressure of 10 tons per sq. in. This provides exceedingly close contact and greatly facilitates chemical reaction among the raw materials.

The moist pellets are then fed to the top section of a vertical chamber, where they gradually descend countercurrent to hot products of combustion generated in the adjacent combustion chamber. After being thus dried and heated to reaction temperature, they fall gradually through the center reaction chamber at a constant temperature of about 2,000 deg. F. Virtually no gas passes upward through this bed.

The fired pellets are cooled down to the temperature of the ambient air by means of an upward flow of air in the bottom chamber. They are then discharged at ambient temperature from the bottom of the tower.

Preheated air from the bottom chamber is diverted to the combustion chamber, and is used to burn the fuel.

When the combustion products leave the top of the tower, they have been cooled to about 230 deg. F. by contact with the moist pellets being fed into the tower.

Lignin from Black Liquor

When making lignin from black liquor (the effluent from either the soda or sulphate process of making pulp), the pH of the concentrated liquor is lowered by the addition of an acidification agent such as carbon dioxide gas. This causes the precipitation of sodium lignate from the black liquor. Unless it is first coagulated, however, it is not practicable to recover the sodium lignate by filtration.

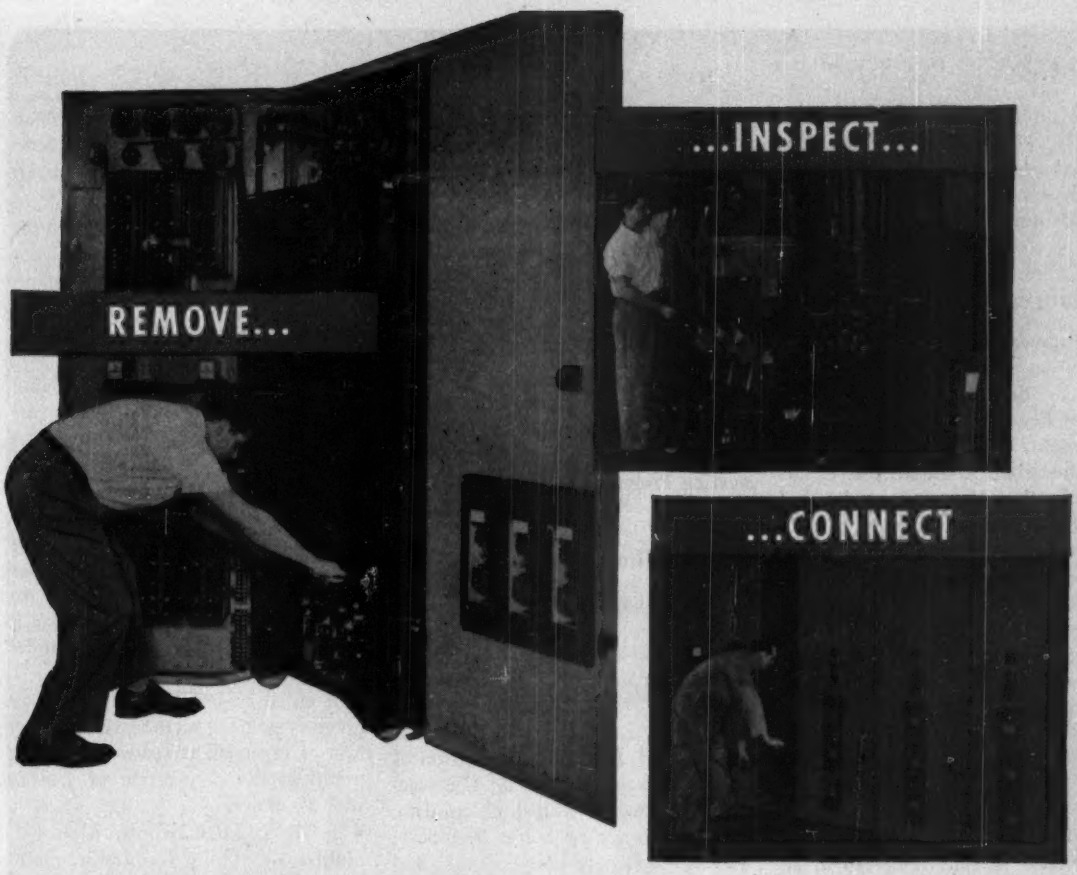
John J. Keilen, Jr., Frank J. Ball and Robert W. Gressang point out in U. S. 2,623,040 that particle size is governed by the degree of agitation of the aqueous suspension at a given temperature.

As originally formed, the gel particles of sodium lignate act as "molecular sponges" which soak up large volumes of liquid. While they are cool these hydrated particles do not tend to agglomerate, possibly due to the protective effect of the water of hydration surrounding each particle. The action of heating, however, permits the particles to diffuse through the hydration layers and actually fuse with adjoining particles.

If left undisturbed, this fusing action and particle growth will continue until the total amount of lignin present is in the form of one liquid mass. By maintaining mild agitation, the particles can be kept from fusing to one mass while still growing large enough to facilitate filtering. If very violent agitation is used, the particles tend to remain too small for ready filtering.

After the particles of desired size are formed, they are kept from fusing completely by cooling the liquor while keeping it in the desired state of motion.

The process, which is assigned to West Virginia Pulp and Paper Co., is carried out by passing a stream of the acidulated black liquor through a heating coil at 185-220 deg. F. and at a



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J-60792



Reynolds number below the turbulent range (i.e., below 2,100). The liquor is then immediately cooled by passing it through a cooling coil at the same Reynolds number.

Low-power Air Rectification

The power requirements for air rectification can be substantially reduced by the method described by Manson Benedict in U. S. 2,627,731. The patent, which has been assigned to Hydrocarbon Research, Inc., claims not only the separation of air, but also the separation of any gaseous mixture by similar means.

Gaseous nitrogen, taken as overhead from the rectification column, is compressed and divided into two streams. One stream is used to heat a reboiler located at an intermediate point in the column.

The other is further compressed and used to reboil the bottoms (oxygen). This stream is then partly decompressed by passing through an expansion valve.

The two streams are further decompressed by passing through an expander, providing most, if not all, the refrigeration required in the process.

The use of an intermediate reboiler saves power because it provides the necessary vapor loading at the top of the column through the use of medium-pressure, instead of high-pressure, nitrogen. This is possible because the temperature is lower in the middle than at the bottom.

The intermediate reboiler also permits construction of a smaller bottom section, since smaller vapor loads are used below the intermediate reboiler. Power savings of 5-7 percent are claimed by Benedict.

A detailed explanation of the general theoretical basis for the use of intermediate reboilers has been given by the inventor in *Chemical Engineering Progress*, 43, p. 41, 1947.

Production of Silanes

In a series of nine patents, Dow Corning Corp. and the Dow Chemical Co. disclose methods of production of a wide variety of silane compounds.

• In U. S. 2,626,266 and 2,626,267, by Arthur J. Barry, the production of arylhalosilanes is discussed. The reaction of benzene with trichlorosilane in the presence of boron trichloride yields diphenyl-dichlorosilane and other products, depending on the proportions of the reactants used. The reaction of benzene with monohydrotrichlorosilane in the presence of aluminum chloride yields phenyltrichlorosilane and valuable derivatives.

• In U. S. 2,626,268, also by Mr. Barry, aliphatic silanes are produced by heating an olefin such as ethylene or propylene with methyl dichlorosilane (or other hydrocarbon halosilanes) under pressure.

• In U. S. 2,626,269, Barry discusses methods of producing aromatic halosilanes such as chlorophenyltrichlorosilane by reaction in an autoclave of chlorobenzene and trichlorosilane in the presence of boron chloride.

• In U. S. 2,626,270, methods of production of tertiary butyl silanes are disclosed by Leo H. Sommers. A chlorosilane such as trichlorophenylsilane is reacted with t-butyl-lithium.

• In U. S. 2,626,271, by Arthur Barry and Donald E. Hook, the production of organosilanes such as ethyl or propyl trichlorosilane is discussed. An olefin such as ethylene or propylene is reacted with trichlorosilane under pressure.

• In U. S. 2,626,272, John L. Speier presents general methods of production of organoalkoxysilanes which are useful in the preparation of organosilyl alcohols.

• In U. S. 2,626,273, by Melvin J. Hunter and Philip C. Servais, methods are given for preparing alkoxy hydrosilanes which can be hydrolyzed and condensed on the surface of cloth, paper and ceramics without the formation of undesirable byproducts.

• In U. S. 2,628,243, Arthur J. Barry and John W. Gilkey reveal a method for preparing organochlorosilanes.

Your Check list of New Process Patents

Product or Process . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Catalysts	Preparation of zinc aluminate spinels	Standard Oil Development Co	2,623,020
	Formation of attrition-resistant Fischer-Tropsch catalyst	Standard Oil Development Co	2,623,021
	Preparation of sintered hydrocarbon-synthesis catalyst bed	Standard Oil Development Co	2,623,022
	Manufacture of platinum-containing catalysts	Universal Oil Products Co	2,623,860–1
	Oxidation regeneration of cobalt catalysts	The Texas Co	2,626,246
	Preparation of metal oxide gel catalysts	Standard Oil Development Co	2,627,506
	Catalyst regeneration	Sinclair Refining Co	2,628,157
Detergents	Production of alkyl-aryl sulfonate detergents	Phillips Petroleum Co	2,628,200
Edible Products	Sugar purification	John P. Barta	2,626,878
Fats, Oils and Waxes	Production of drying oils	California Research Corp	2,623,056
	Production of drying oils	Universal Oil Products Co	2,624,717
	Solvent fractionation of wax-containing mixtures	The Atlantic Refining Co	2,626,230–1
	Diglyceride preparation	Proctor & Gamble Co	2,626,952
	Hydrogenation and winterising of soya oil	The Best Foods, Inc	2,627,467–9
	Manufacture of synthetic drying oil	Lee Pritzker	2,627,479
	Steam distillation of fatty acids and oils	Armour & Co	2,627,500
Fuels	Manufacture of producer gas	General Electric Co	2,622,972
	Desulfurization of distillate fuels	Standard Oil Co. (Ind.)	2,623,004
	Gasification of solid fuels	Standard Oil Development Co	2,623,815
	Production of high-heating value fuel gas	Hydrocarbon Research, Inc	2,623,816
	Production of fuel gases	Standard Oil Development Co	2,623,817
	Continuous carbonization of coal and oil mixtures	The Lummus Co	2,624,696
	Coking of oils in a fluidized state	Sinclair Refining Co	2,624,697
	Gasification of coal with oxygen and steam	Union Oil Co	2,627,455
	Catalytic distillation of shale	Standard Oil Development Co	2,627,499
Gases	Production of H_2 from Mg powder and salt water	Edwin A. G. Liddiard	2,623,812
	Method of purifying inert gases by adsorption	General Electric Co	2,624,421
	Production of HCN	The Babcock & Wilcox Co	2,625,463
	Continuous generation of CO from coke and oxygen	Sinclair Refining Co	2,625,465
	Air fractionation	Air Products, Inc	2,626,510
Hydrocarbons	Polymerization with a fluid solid catalyst	Standard Oil Development Co	2,626,289

Junior's doing well



New nitric acid plants at Sheffield, Alabama

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Product or Process . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Hydrocarbons, cont.	Polymerisation of olefins with a phosphoric acid slurry catalyst	Standard Oil Development Co.	2,626,290-3
	Process for breaking petroleum emulsions	Petrolite Corp.	2,626,901-2,626,929
	Extraction of tertiary olefins	Universal Oil Products Co.	2,626,959
	Alkylation of aromatics with isoparaffins	Sun Oil Co.	2,626,966
	Hydrogenolysis of hydrocarbons	Phillips Petroleum Co.	2,627,495
	Urea-separation of aliphatics	Standard Oil Development Co.	2,627,513
	Use of a gas lift as a conversion zone	Houdry Process Corp.	2,628,188
Inorganic Chemicals	Production of phosphorus compounds	International Minerals and Chemical Corp.	2,622,965
	Removal of bromine from brine	Frank F. Lindstaedt and David L. Shatto	2,622,966
	Manufacture of manganese carbonate	Reginald S. Dean	2,625,462
	Manufacture of zirconium compounds	United States of America	2,626,203
	Production of sodium sesquicarbonate	Kaiser Aluminum & Chemical Corp.	2,626,852
	Selective carbonation of $Ca(OH)_2$ and $Mg(OH)_2$ slurries	The Phillip Carey Mfg. Co.	2,626,853
	Preparation of lithium chloride from spodumene	Scientific Design Co., Inc.	2,627,452
	Electrolysis of alkali metal compounds	Mathieson Chemical Corp.	2,627,501
	Chromates and vanadates recovery from water solution	Diamond Alkali Co.	2,626,154
Organic Chemicals	Sulfating polyvinyl alcohol	Phillips Petroleum Co.	2,623,037
	Catalytic reaction of ammonia and olefins	Sinclair Refining Co.	2,623,061
	Azeotropic separation of cyclopentinnone	Phillips Petroleum Co.	2,623,072
	Extractive distillation of isoprene with dimethyl sulfolane	Standard Oil Development Co.	2,623,844
	Distillation of wood carbonization products	Etablissements Lambiotte Freres	2,623,845
	Hydrogenation of aldehydes and ketones	The M. W. Kellogg Co.	2,623,893
	Purification of m-nitro-para-toluidine	The Sherwin-Williams Co.	2,623,903
	Hydrolysis of 1, 2-propylene oxide to 1, 2-propylene glycol	Celanese Corp. of America	2,623,909
	Alkylation and isomerisation of alkylated aromatic hydrocarbons	Koppers Co., Inc.	2,623,911
	Preparation of maleic anhydride	Monsanto Chemical Co.	2,624,744
	Vapor-phase oxidation of benzene to maleic anhydride	Monsanto Chemical Co.	2,625,554
	Purification of naphthalene	Koppers Co., Inc.	2,626,236
	Cyclopentadiene recovery from coke-oven light oil	National Steel Corp.	2,626,285
	Catalytic dehydrogenation of naphthenes and olefins	Standard Oil Development Co.	2,626,286
	Production of halo-olefinic compounds	Universal Oil Products Co.	2,626,963
	Production of vinyl fluoride	Union Carbide & Carbon Corp.	2,626,963
	Recovery of glucuronolactone	Corn Products Refining Co.	2,627,520
	Preparation of polyamides	E. I. du Pont de Nemours & Co.	2,628,219
	Liquid-phase esterification	Pittsburgh Coke & Chemicals Co.	2,628,249
	Preparation of aromatic aldehydes	United States of America	2,628,256
	Production of unsaturated aldehydes	Union Carbide & Carbon Corp.	2,628,257
	Process for making vinyl- and vinylidene chlorides	The Dow Chemical Co.	2,628,259
	Catalysed and continuous chlorination of benzene	The Dow Chemical Co.	2,628,260
Plastics	Polymerisation of trifluorochloroethane	United States of America	2,626,254
	Production of organic cellulose acid esters	Celanese Corp.	2,627,515
	Polymerisation of methacrylonitrile	Shell Development Co.	2,628,222
Rubber	Purifying and concentrating hevea rubber latex	Firestone Tire & Rubber Co.	2,626,969
Synthesis Gas and Processes	Activated iron catalyst for synthesis reactions	Stanolind Oil & Gas Co.	2,626,274
	Dilution of catalyst with inert solid particles	Hydrocarbon Research, Inc.	2,626,275
	Recovery of organic oxygen compounds	Standard Oil Development Co.	2,626,276
	Fluidised iron oxide-natural gas process for synthesis gas	Phillips Petroleum Co.	2,628,161
Synthetic Fibers	Extruding a solution of polybutadiene through an orifice into a solution of SO_2	Shell Development Co.	2,622,962
	Polymerisation of acrylonitrile	E. I. du Pont de Nemours & Co.	2,628,223

. . . And New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Adsorption	Tower adapted for regeneration of the adsorbent	National Tank Co.	2,626,675
Crushing and Grinding	Jaw crusher	Hiram L. Barber and George L. Sellars	2,626,759
	Coal crusher	George E. Krider	2,628,037
	Stationary pulveriser for rotary beater mills	Riley Stoker Corp.	2,628,038
	Attrition mill	Allis-Chalmers Manufacturing Co.	2,626,757
Diffusion	Aerogel barrier diffuser for separation of H_2	Sinclair Refining Co.	2,627,933
Distillation	Method for preventing coke formation in towers	Standard Oil Development Co.	2,626,894
Drying	Conveyor type systems for vertical drying ovens	Carl F. Mayer	2,628,087
Extraction	Solvent extraction of fats or oils	The French Oil Mill Machinery Co.	2,626,265
Filtration	Rotary-drum suction filter	Davey, Paxman & Co., Ltd.	2,626,058
Fluid and Particle Transfer	Fluidised solids flow controller	Standard Oil Co. (Ind.)	2,626,247
	Electromagnetic pump	McGraw Electric Co.	2,627,811
	Proportional pumping apparatus	The DeLaval Separator Co.	2,627,813
Gas-solids Separation	Electrical precipitator	Westinghouse Electric Co.	2,626,008
	Cottrell-type electric precipitator	Research Corp.	2,626,676
Heat Transfer	Modified up-draft tube heaters	Universal Oil Products Co.	2,625,916-7
	Upshot heater	Thomas M. Lumly	2,625,918
	Moving-bed heater	Babcock & Wilcox Co.	2,626,141
	Pebble heater	Phillips Petroleum Co.	2,626,287
	Pebble heater	Babcock & Wilcox Co.	2,626,795
	Cooling tower	Edward Simons	2,627,396
	Pebble heater	Phillips Petroleum Co.	2,627,497
	Indirect heat transfer between solid particles and heat transfer medium	The New Jersey Zinc Co.	2,626,077
Instrumentation	Program flow control system	Infilco, Inc.	2,627,280
	Relative humidity indicator	Davison Chemical Co.	2,627,505
	Indicating-controlling apparatus for flash points	California Research Corp.	2,627,745
Ion Exchange	Regeneration of ion-exchangers	The Permutit Co.	2,628,191 & 4
Liquid-liquid Extraction	Oil-water separator for installation in a pipe	Selas Corp. of America	2,626,709
	Centrifugal separator	Emil L. Ranseen	2,626,747
Liquid-solid Separation	Decanting device	The Permutit Co.	2,622,736
	Continuous horizontal centrifuge	The Sharples Corp.	2,622,794
	Centrifugal separator	The Black-Clawson Co.	2,622,795
	Centrifuge for rapid extraction of fine particles from suspension	Bird Machine Co.	2,625,320
	Continuous centrifuge with underflow return circuit	Merco Centrifugal Co.	2,625,321
	Centrifuge	Ethel K. and Mary E. Haferkamp	2,626,745
	Centrifuge	Samuel L. Abbott	2,626,746
	Floating thickener	Paul A. Curtis	2,627,978
	Centrifuge with auxiliary feed arrangement	Aktiebolaget Separator	2,628,021
Mineral Dressing	Flotation apparatus	Robert Carbonnier	2,626,052
Mixing	Jacketed conical blender	Patterson Foundry & Machine Co.	2,628,080
	Paint mixer	T. J. Laird Equipment Co.	2,628,081
Reactors	For catalytic endothermic and exothermic reactions	Universal Oil Products Co.	2,626,204
	Gravity bed reactor	Sinclair Refining Co.	2,626,205

—End

WHY 2 OF DENVER'S 5 REFINERIES SELECTED NICHOLSON STEAM TRAPS

may be important to you

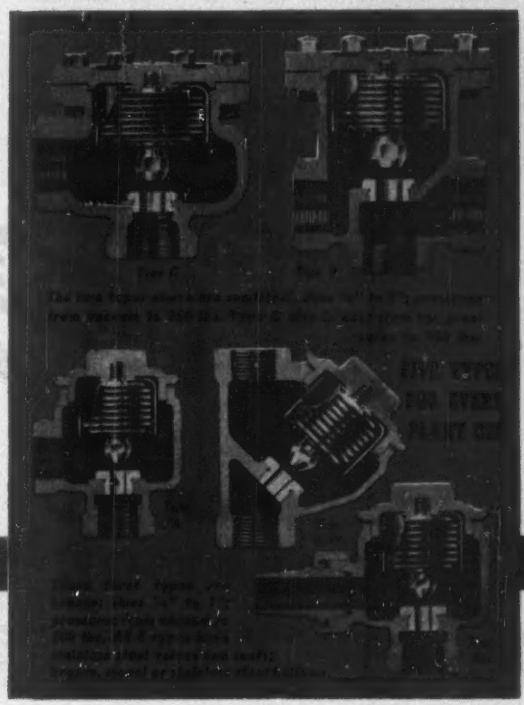
LIKE many industrial plants, the two operations referred to above had been using a considerable number of different kinds of steam traps. Both refineries have standardized on Nicholson traps, for practically all applications, for these basic reasons: Nicholson traps were found to be the most effective in improving heat transfer and in promoting production efficiency. These are advantages which, we believe, are of interest and importance to plant men in every industry.

A recent survey showed these Nicholson features to be reasons why an increasing number of leading plants are standardizing on Nicholson thermostatic traps:

1) Two to six times average drainage capacity; shorten heat-up time.
2) Operate at lower temperature differential; fast action keeps equipment full of live steam; higher and more even temperatures.
3) No air binding; eliminate costly fluctuation of operating temperatures.
4) Freeze-proof; drain completely when cold; can be freely installed outdoors.
5) Only one moving part; minimum maintenance.
6) No need to change valves for varying operating pressures from vacuum to maximum allowable.
7) Record low for steam waste; as little as 1%.

Types for every process, power and heat application.

Send for
CATALOG 751
Contains installation diagrams and data for determining proper size of trap.



NICHOLSON
TRAPS · VALVES · FLOATS
206 OREGON ST., WILKES-BARRE, PA.

Sales and Engineering Offices in 38 Principal Cities



BUILDERS
FOR INDUSTRY

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BECHTEL CORPORATION

Los Angeles • **SAN FRANCISCO** • *New York*

Services include analysis, design, engineering, procurement and construction of facilities for the manufacture of petrochemicals and other chemicals and chemical products.

Examples of current and recent plants:

Aluminum fluoride
Ammonia and ammonium salts
Aromatics (benzene, toluene, etc.)
Commercial acids
Elemental phosphorus and phosphates
Hydrogenation of coal and oil
Soda ash
Sodium sulfonate
Styrene
Zirconium chloride



The world's most valuable piece of *REAL ESTATE!*

It was from this one soil sample . . . out of tens of thousands from all over the world . . . that a team of scientists in 1950 first isolated the mold growth that produces terramycin. Today, impressive quantities of terramycin produced from this original mold are bringing under control some eighty diseases, including certain serious virus infections.

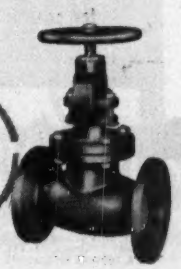
A vast network of pipes and valves regulate the proportion and control the flow of the liquid media in which the antibiotic mold is grown. To safeguard the purity of this vital liquid from harmful contamination ALOYCO Stainless Steel Valves are used in the plant producing terramycin.

Most of the manufacturers of the new wonder drugs such as terramycin, penicillin, chloromycetin, streptomycin, neomycin, as well as other leaders in the chemical industries, have come to use many different types of ALOYCO corrosion-resistant valves. Our long and extremely diversified experience in the field together with our pre-testing of alloys under actual line conditions enable us to supply valves of the proper alloy and best design for every corrosive service.

If corrosives play a part in your business, it will pay you to bring your problems of corrosion, contamination, discoloration, or temperature extremes to the *Aloyco Corrosion Engineering Service*. Here the world's largest specialists in corrosion-resistant valves will help you determine which valves best meet your requirements.

ALOYCO valves go hand-in-hand with chemical progress. 3.6

Longer Lasting
ALOYCO VALVES
1st in Corrosive Service

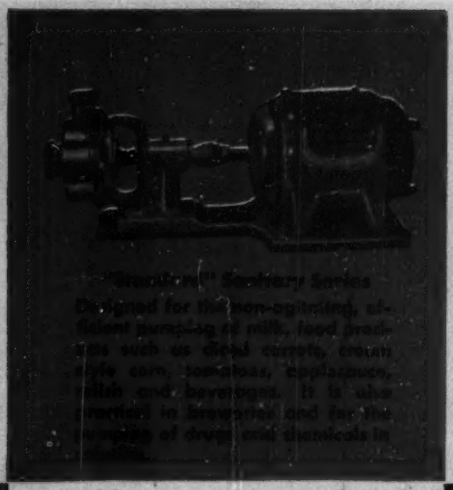


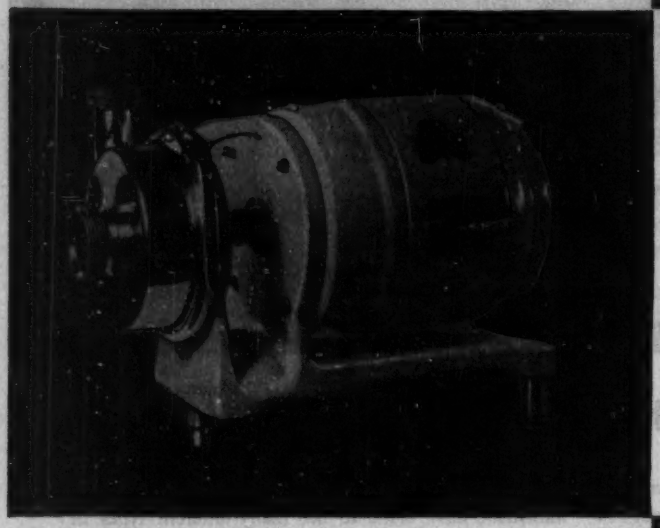
ALLOY STEEL PRODUCTS CO., INC.
1301 West Elizabeth Avenue, Linden, N. J.
Plants: Linden, N. J.; Bloomfield, N. J.; Elizabeth, N. J.

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You'll find all the features you want in TRI-CLOVER PUMPS





"Pump King" Unimount Series

Designed for very efficient operation at 1800 and 3600 RPM, and especially where high speeds are required, through heaters, coolers, filters, clarifiers, etc. The 3600 RPM model is especially applicable in the dairy industry where high head and low capacity are essential and for handling low and medium viscosity liquids in the food processing industry.

OVER 30 years of continuous improvement is embodied in today's line of Tri-Clover centrifugal pumps.

The "Pump King" Sanitary Series—the Standard Sanitary Series—and the Industrial Series—all have exclusive Tri-Clover pump features that mean better, more efficient liquid transmission.

Patented screw type impeller with sanitary impeller clip—inert carbon seal that is easily removed and cleaned—streamlined, lightweight head with a minimum number of parts—simple, fast pump assembly and disassembly with the new Ring Clamp construction—these are just a few features that make Tri-Clover Centrifugal Pumps ideally suited for food, chemical, dairy, and industrial requirements for sanitary and corrosion-resistant service.

Benefit from these important advantages when looking for a solution to your pumping problems.



"Industrial" Series

Designed for pumping latex, water, brine, light oils, chemicals, paints, brewery products, and liquids in the food processing field where lines are of I.P.S. type. This model offers quick disassembly features for ease in cleaning.

See your nearest Tri-Clover distributor, or write for a copy of Pump Catalog 250.

P-153

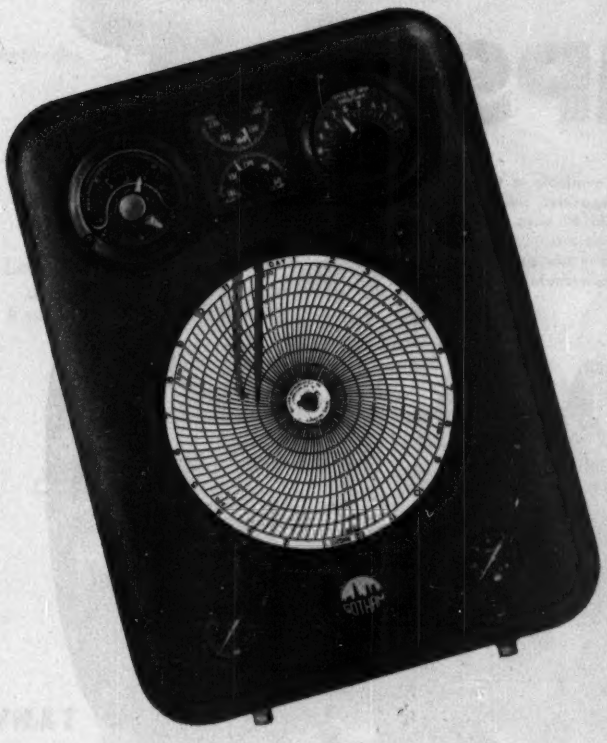
Tri-Clover®
MACHINE CO.
Kenosha, Wisconsin

TRIALLOY AND STAINLESS STEEL SANITARY FITTINGS, VALVES, PUMPS, TUBING, SPECIALTIES

FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS

THE Complete LINE

NEW PROGRAM CONTROLLER AS EASY TO ADJUST AS YOUR RADIO



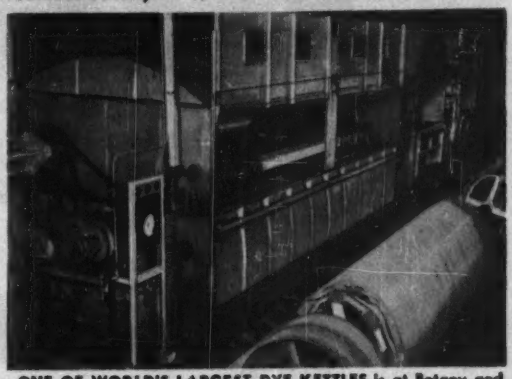
Gotham, first to bring you a completely enclosed Program Controller, was also first to conceive of all adjustments from the outside of the case. With the new Gotham Program Controller, incorporating the new outside adjustment principle, you can set the time, rate of rise, hold, and rate of cooling as easily as you tune your radio. You can control either temperature or pressure vs. time. Write for Catalog No. 500 describing in full the construction, operation, and application of the new Gotham Program Controller.

GOTHAM INSTRUMENTS

Keep Everything Under Control With Gotham

60 Gotham PC's at Botany

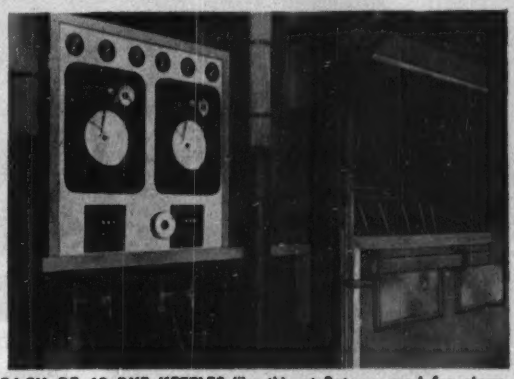
Over 60 Gotham Program Controllers are in use by famous Botany Mills, Inc., Passaic, N. J.



ONE OF WORLD'S LARGEST DYE KETTLES is at Botany and its dyeing cycle is supervised by Gotham Program Controller. Program control helps to maintain uniformity of the color.



12 TOP DYE KETTLE program controller units by Gotham are installed at Botany. Program control enables Botany to adjust quickly the variable time cycles required to get level dyeing.



EACH OF 48 DYE KETTLES like this at Botany, used for piece goods, is individually handled by its own Gotham Program Controller.

Photos courtesy of Botany Mills, Inc.

GOTHAM INSTRUMENTS
Division of American Machine & Metals, Inc.
Dept. S, 233 Broadway, New York 12, N. Y.
Please send me a copy of your latest catalog and more information about Gotham ☐ Program Controllers ☐ Timers ☐ Recorders ☐
Have your man call. No obligation, of course.



Name _____ Title _____

Company _____

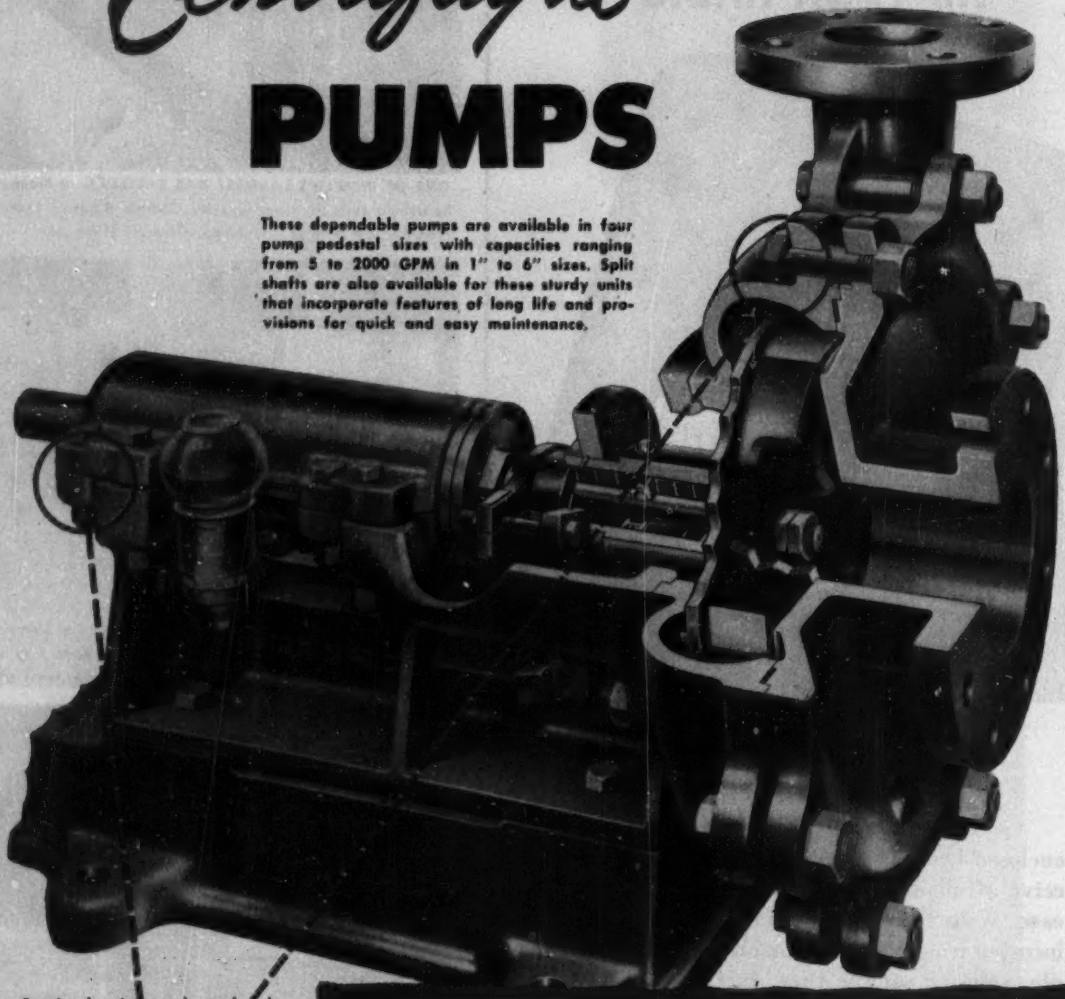
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City _____ Zone _____ State _____

MISSION

Centrifugal PUMPS

These dependable pumps are available in four pump pedestal sizes with capacities ranging from 5 to 2000 GPM in 1" to 6" sizes. Split shafts are also available for these sturdy units that incorporate features of long life and provisions for quick and easy maintenance.



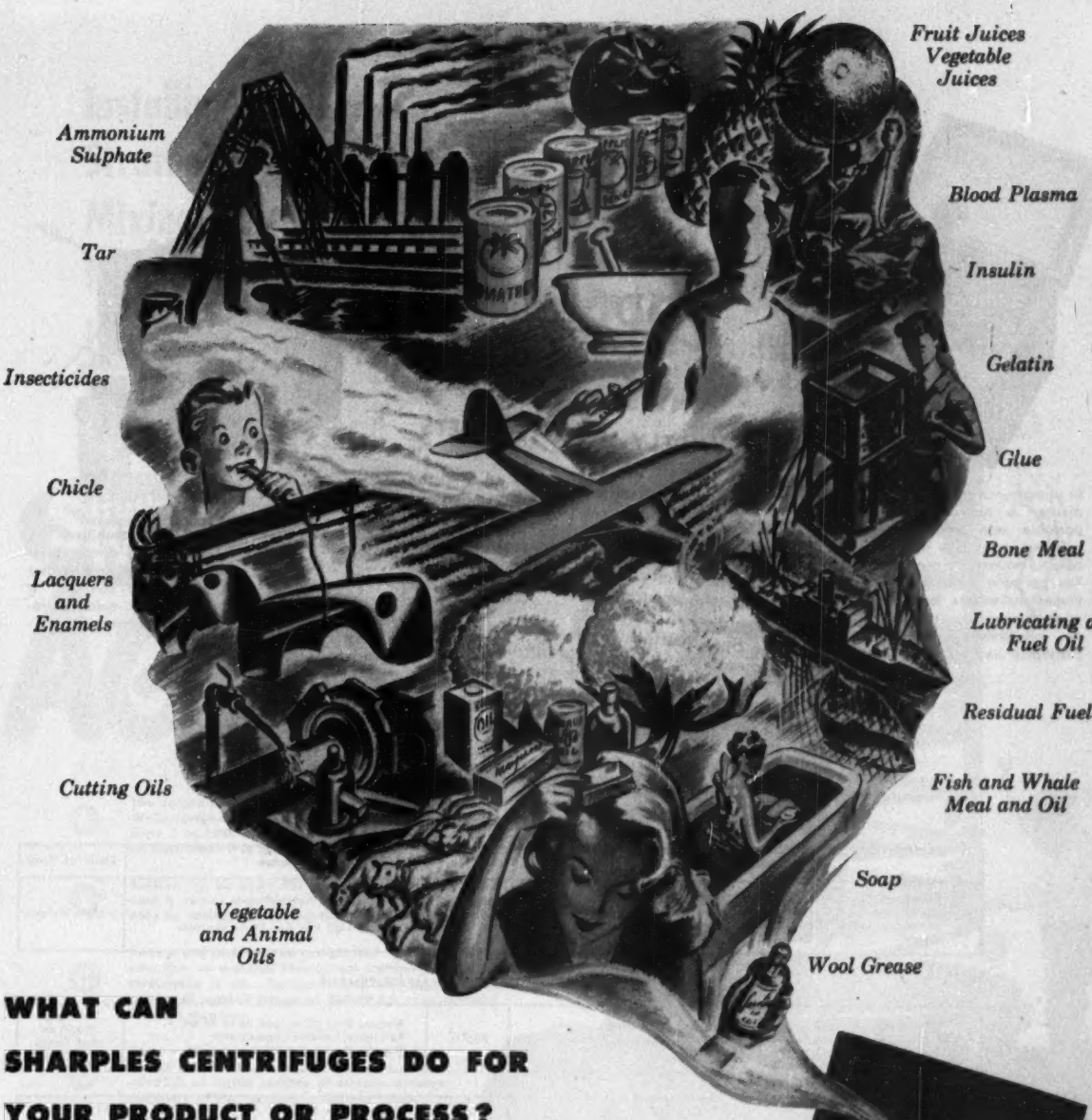
Bearing housing can be replaced completely without disturbing pedestal alignment or casing. Quick inspection of impeller and casing and easy replacement if necessary.

Mission Centrifugal Pumps have proved far superior in handling corrosives, abrasives, and many other miscellaneous difficult materials. Their construction includes a selection of various corrosive resistant alloys — including plastic — to provide durable and long-lasting performance under the most severe operating conditions. Impeller clearance can be easily adjusted externally. Open pedestal construction allows fast installation and service of packing and mechanical seals. Prompt, dependable, efficient service goes with all Mission products. Saves time and money for Plant operators. Dependable performance guaranteed. For specific applications, let us quote on your requirements; specify: discharge and suction head . . . capacity . . . material to be pumped . . . specific gravity . . . temperature . . . viscosity . . . and any special conditions. Write today for descriptive folders that give complete information about the many benefits of using Mission Centrifugal Pumps.

MISSION MANUFACTURING CO.

HOUSTON, TEXAS

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Handled by representatives in all industrial areas . . . and by supply stores in every oil country.

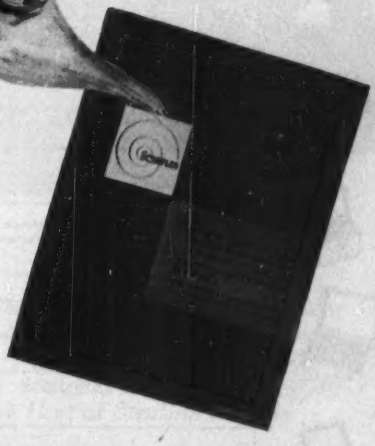


WHAT CAN

SHARPLES CENTRIFUGES DO FOR

YOUR PRODUCT OR PROCESS?

Bulletin 1259 describes the SEVEN BASIC TYPES of SHARPLES CENTRIFUGES which may offer economies in the continuous clarification, separation, crystal dehydration, concentration, or classification of your products. Just ask for Bulletin 1259.



It pays to start with Sharples...

SHARPLES

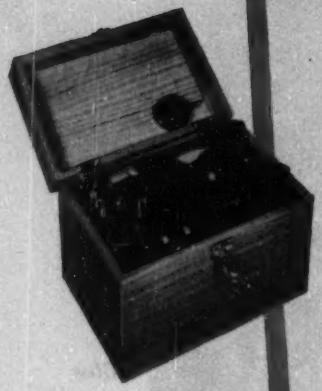
THE SHARPLES CORPORATION • 2300 WESTMORELAND STREET, PHILADELPHIA 40, PENNA.

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FOR

"on-the-spot" checking...

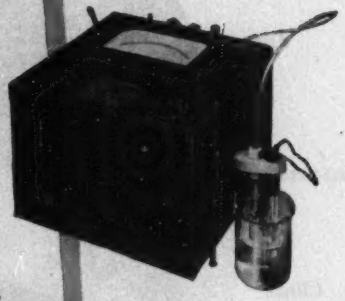
INVESTIGATE THESE WIDELY-USED TEST SETS



In appearance the 8657-C Indicator is typical of L&N portable test sets and is outstanding for fully dependable, moderate precision. The portable series also includes instruments for measuring temperature, electrolytic conductivity, electrical resistance and pH.

High on any list of "musts" for making spot-checks of production processes and equipment are these L&N Test Sets. For these versatile instruments combine the portability, ruggedness and simplicity of design needed for plant use, with the accuracy and flexibility necessary for use in the laboratory.

Specifications for just a few of these instruments that are particularly useful to the Chemical Process Industries appear below. For more complete information, contact our nearest office or write 4916 Stenton Ave., Phila., Penna.



The 7664 L&N Stabilized pH Indicator gives direct readings in pH in either grounded or ungrounded solutions. It is also used in oxidation-reduction measurements.

FOR pH AND REDOX MEASUREMENT

Instrument	List No.	Range	Limit of Error
Stabilized pH Indicator—for direct reading in pH; also for oxidation-reduction measurements. May be used in grounded or ungrounded solutions. For operation on 115 volts, 60 or 50 cycles.	7664	0 to 14 pH; 0.1 pH divisions 0 to ± 700 mv; d-c; 5 mv divisions 0 to ± 1400 mv; d-c; 10 mv divisions	1 scale division

FOR THERMOCOUPLE EMF MEASUREMENT

Double-Range Portable Millivolt Indicator. For thermocouple voltage measurements—reads in millivolts; manual reference junction compensation.	8657-C	Ranges: 0 to 16 mv and 16 to 64 mv. Reference Junction Compensator Ranges: 0 to 1 mv and 0 to 5 mv.	Low Range: ±0.05 mv. High Range: ±0.15 mv.
Double-Range Portable Millivolt Indicator. A more precise instrument for uses similar to 8657-C.	8662	Ranges: 15 x 1 mv + 1.1 mv slidewire 15 x 5 mv + 5.5 mv slidewire Reference Junction Compensator Ranges: 0 to 1 and 0 to 5 mv	Low Range: ±0.01 mv. High Range ±0.05 mv.

FOR ELECTROLYTIC CONDUCTIVITY MEASUREMENT

Portable Electrolytic Resistance Indicator. For measuring resistance of electrolytic solutions. Operates at 115 volts, 60 cycles.	4960	0.3 to 30,000 Ω	±1%
Portable Conductivity-Resistivity Indicator. For general use in measuring the specific conductance and specific resistance of electrolytic solutions. Operates at 115 volts, 60 cycles.	4866	Specific Conductance: 0.012 to 0.000,0001 mho per centimeter cube. Specific Resistance: 80 to 10,000,000 Ω per centimeter cube.	±0.3%

FOR RESISTANCE MEASUREMENT

Type S-2 Portable Wheatstone Bridge. For ordinary resistance testing.	5305	Useful range: 1 to 50,000 ohms direct measurement. Will measure approximate resistance at lower and higher values.	±.15%

LEEDS NORTHRUP

instruments *automatic controls • furnaces*

Journal Ad. No. E-0600(1a)

Installing another Struthers Wells Mixing Vessel for processing HEAVY VISCOUS MATERIALS



Struthers Wells *Double motion*

AGITATOR

A The double motion drivehead is an exclusive Struthers Wells design and is available in Horse Powers ranging from 2 to 150, and is furnished with proper sealing devices when it is used on pressure kettles.

B Kettles can be open flat top as shown or equipped with a dished and flanged or similar closed top suitable for working pressures as high as 300 lbs.

C Sweep and paddle arms are pitched to create a definite flow of material throughout kettle—preventing stratifying of mix. Scraper frame and paddle arms can be of welded design or bolted for easy removal through manway.

D Scraper blades are of advanced hinged type design, which insures positive scraping action on 98% of inside surface of mixer—without necessity of boring shell or bottom head.

E Constructed of any standard steel or special alloy to meet most exacting specifications.

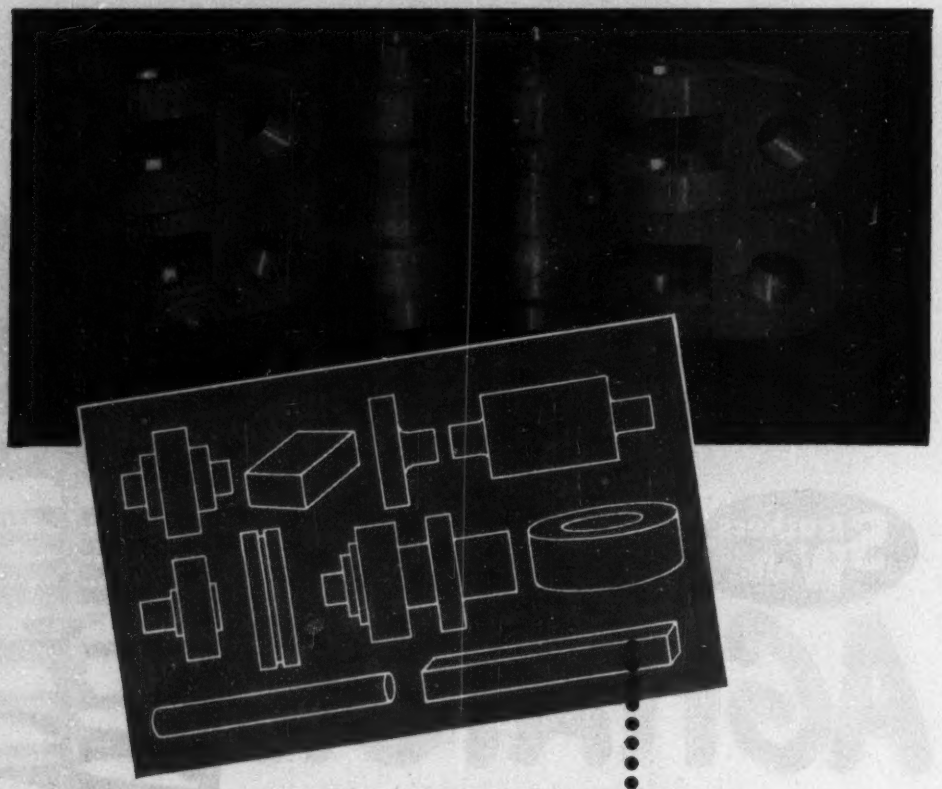
F Kettles are furnished with jacket or unjacketed for direct fire applications.

For speed, economy and dependability—specify the Struthers Wells Double Motion Mixing Vessels—for processing greases and other heavy viscous materials. Our extensive machine shops and fabricating facilities—combined with years of engineering experience in designing all types of agitating vessels, enable us to furnish mixing equipment for any material, to your most rigid specifications.

For intricately designed or standard mixing equipment—*think first of Struthers Wells.*

Struthers Wells CORPORATION

PROCESSING DIVISION • WARREN, PA.
PLANTS AT WARREN AND TITUSVILLE, PA.



Stainless Steel Forgings *to Your Specifications*

RINGS...DISCS...BLOCKS...BARS...SHAFTS
SPINDLES...HUBS...SPECIAL SHAPES

Desired forgings in the available types of stainless and heat-resisting steels are produced in a wide range of shapes and sizes by our Forging and Casting Plant, noted for uniformly consistent properties and finish.

Experienced personnel, complete laboratory control facilities, excellent equipment and substantial capacity combine to assure quality and service.

A-L offers assistance in grade selection, along with suggestions as to finishing and application—remembering the need for making the supply of stainless go farther and be of permanent value to our national productive economy. ● *Allegheny Ludlum Steel Corporation, Forging and Casting Division, Wanda & Jarvis Avenues, Detroit 20, Michigan.*

Rough Machining
Heat Treating

We can supply clean, top-quality stainless forgings either "as is," or rough machined, heat treated, etc.

Any Allegheny Ludlum field representative will gladly give you further particulars, or write us direct.

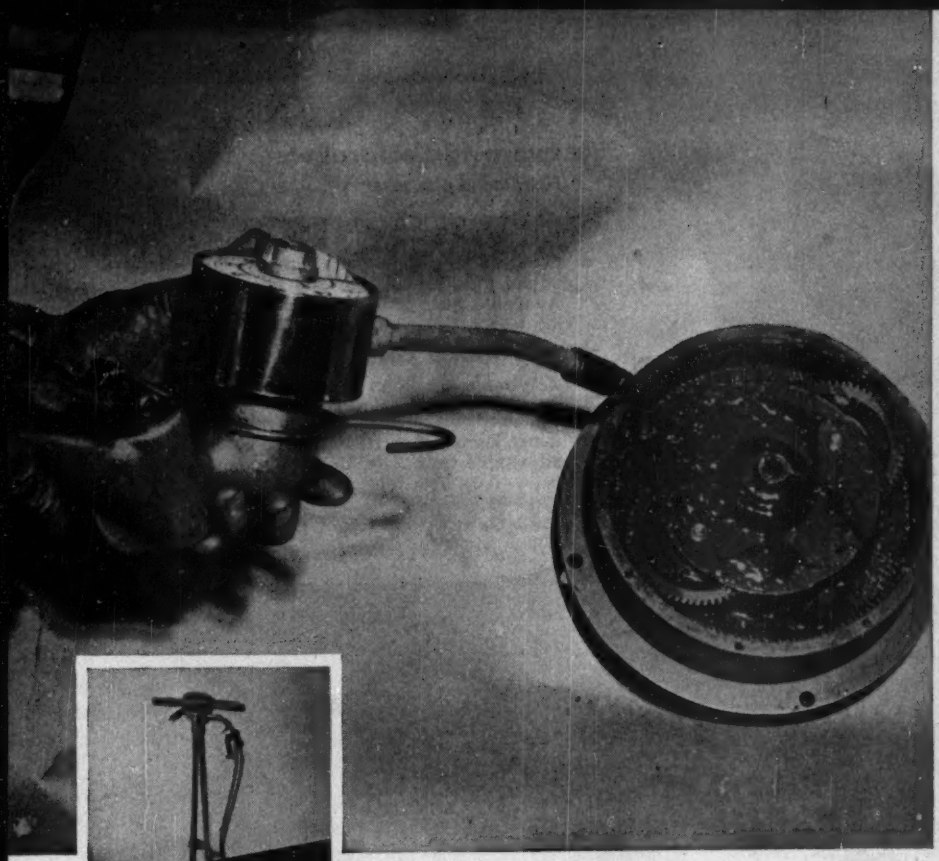
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You can make it **BETTER** with

Allegheny Metal

WAD 8870

AL
TIME-TESTED STAINLESS STEEL





Solves leakage problem . . .

● Multi-clean Products, Inc., St. Paul, Minnesota, manufactures industrial floor polishing and scrubbing machines. The machines are shipped with grease already installed in gear reduction units. The problem faced by this company was one of finding a grease that would stand up under hard service and not leak from the gear units. Greases tried either caused or threatened leakage troubles.

Called in on this problem, a Standard Oil lubrication specialist recommended STANOBAR Grease "S", a highly stable grease with a unique adhesive characteristic. Given an accelerated service test, STANOBAR did not leak from the gear unit, and its consistency showed no change that would later cause a leakage problem. There was no wear of gears or bearings. Adopted for use in the units, STANOBAR has solved this company's lubrication problem on every count. Officials have been able to eliminate the costly and troublesome practice of having all units returned to the factory, at 12 months intervals, to be repacked with grease.

STANOBAR
TRADE MARK
Grease

The same lubricating qualities of STANOBAR that solved this problem for Multi-clean Products, Inc. can serve you in a wide variety of applications. A Standard Oil lubrication specialist will be glad to discuss those applications with you. He's right there in your section of the Midwest. You need only phone your local Standard Oil office. Or write, Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

What's YOUR problem?



C. L. Daub is the Standard Oil lubrication specialist who helped Multi-clean Products, Inc. solve an important lubrication problem through his recommendation of STANOBAR Grease.

Like all Standard Oil lubrication specialists, he has a broad background of practical experience plus thorough training in Standard's own schools. And like all lubrication specialists, his on-the-job assistance is always available to the industries in the immediate area he serves. He is one of a corps of experienced men who make their headquarters wherever industry is located throughout the Midwest. Call for the services of your Standard Oil lubrication specialist today. When he stops at your plant, be sure to get information on these outstanding products:

STANOIL Industrial Oils.—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in compressors, gear cases, and circulating systems. One of two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—On open gears and wire rope, these greases resist washing and throw-off. Their superior wetting ability affords better coating of gears and better internal lubrication of wire rope.

STANORUST Rust Preventives—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specially developed for its intended use. The grades range from a fingerprint remover to a heavy semi-solid that protects against corrosion for years under the most severe outdoor exposure.

STANDARD OIL COMPANY

STANDARD *(Indiana)*



★ two-mode controllers

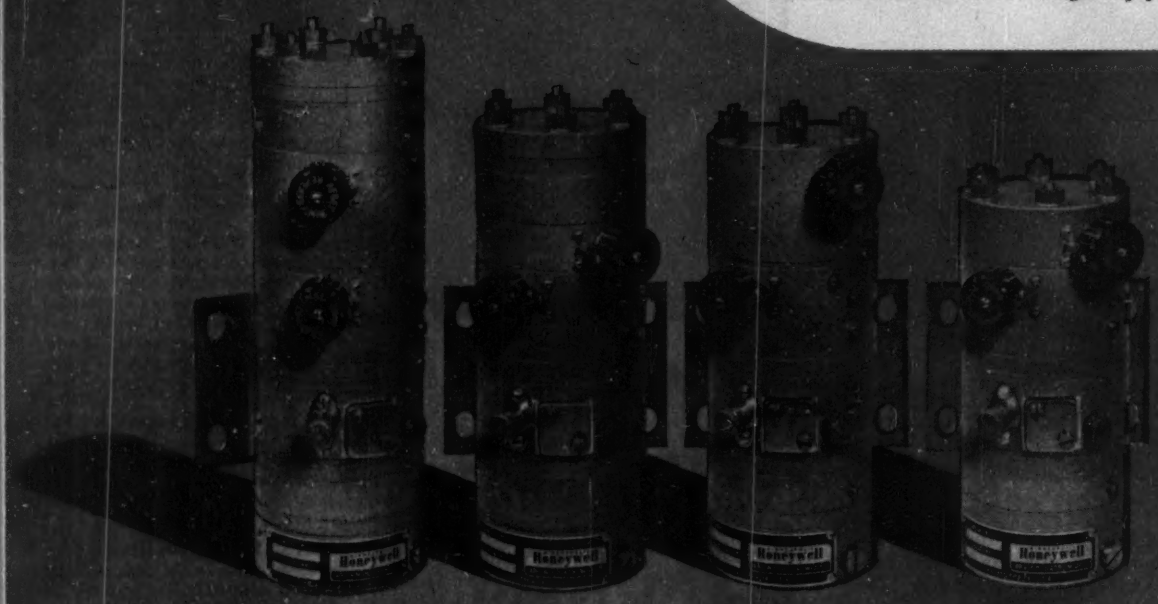
Fixed band plus reset

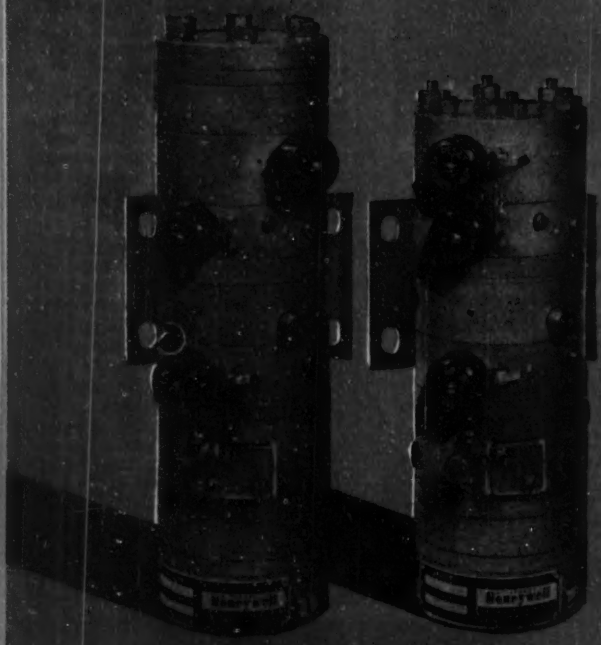
Amply sensitive for many processes, these models have proportional band set at 150%. Especially designed for flow applications, with reset action adjustable from 0.2 to 100 repeats per minute. Available with or without integral by-pass relay.

★ two-mode controllers *(Below)*

Adjustable band plus reset

For processes with short time lags, as well as for many having slow response. Proportional band is adjustable from 2 to 150%. Choice of slow reset type—0.01 to 5 repeats per minute, or fast reset type—0.2 to 100 repeats per minute. Both types available with or without integral by-pass relay.





★ three-mode controllers

Proportional plus rate plus reset

The newest additions to the *Tel-O-Set* line, these controllers are applicable to processes with slow response or long time lags . . . such as are often encountered in temperature applications and in certain pressure control work. During automatic start-up, in particular, rate action *prevents* overshooting . . . brings the process in line more quickly and smoothly than simpler control could do.

All three modes are adjustable. Proportional band: 2 to 150%. Reset rate: 0.04 to 20 repeats per minute calibrated range, increasable to about 70 per minute. Rate time: calibrated range 0.02 to 10 minutes; minimum time about ¼ second. Available with or without integral by-pass relay.

Choose a **Tel-O-Set controller** *for the performance* your *job requires*

WHATEVER your specific application may demand in the way of fast-acting pneumatic control, you'll find exactly the right answer in the *Tel-O-Set* controller family. You can select the model that gives the type of control that fits your specifications to a "T" . . . and not be over-sold nor under-equipped . . . but *just right* in economy and performance.

Each of the eight models offers such *Tel-O-Set* features as sealed-tight design, non-bleed pilot valve, simplified tuning, easily-read dial calibrations. Each utilizes the pneumatic balance principle . . . responds instantly to process changes. Dead zone is less than 0.04 psi. Applications cover pressure, liquid level, flow and temperature.

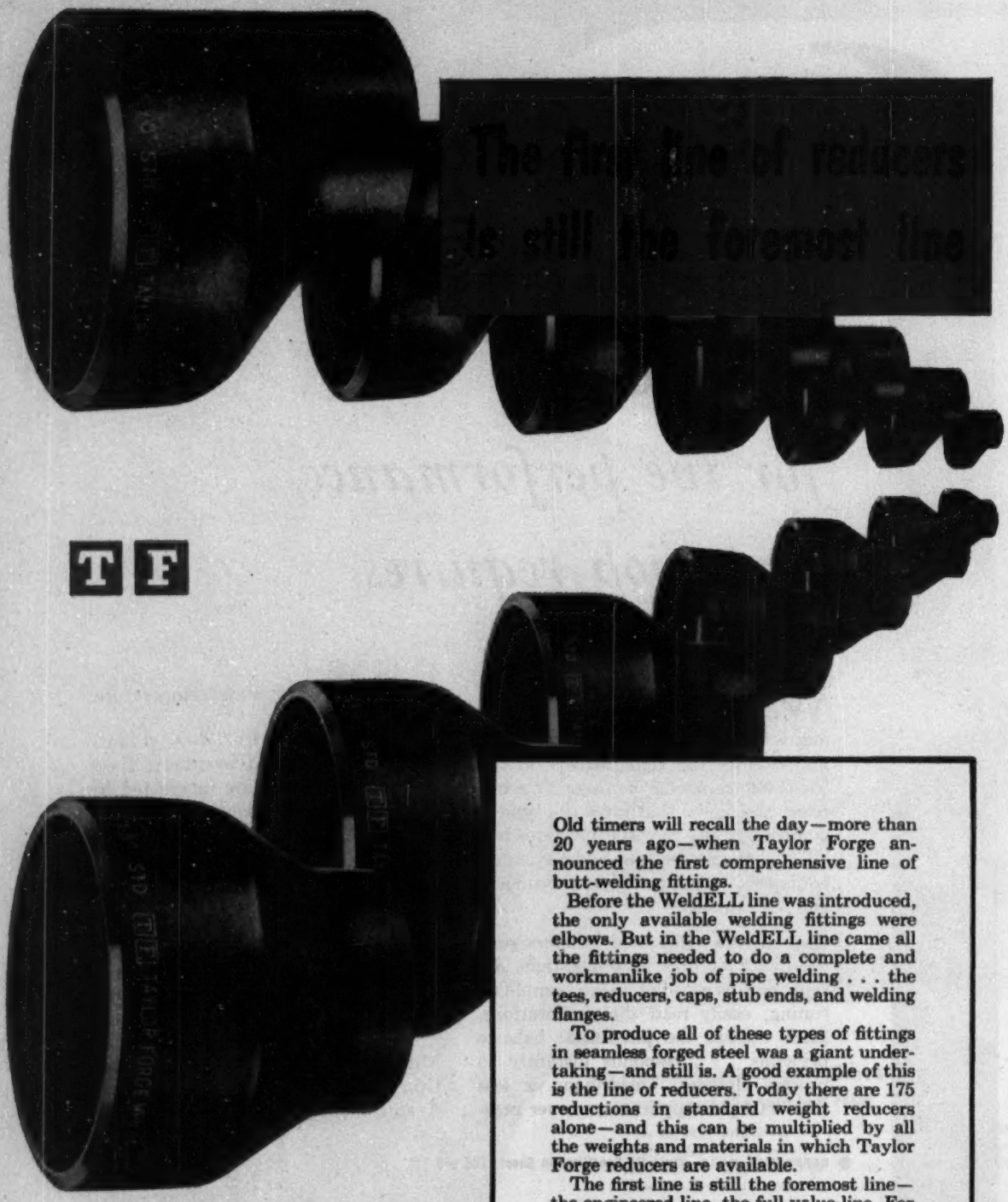
Designed to work with *Tel-O-Set* miniature indicators and recorders, these compact controllers are unaffected by vibration and ambient temperature changes. They need practically no maintenance . . . can have a split manifold to permit removal of the controller while on manual by-pass.

Your local Honeywell engineering representative will be glad to discuss your control applications . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Specification Sheets 768 and 771.**

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls



T F

Old timers will recall the day—more than 20 years ago—when Taylor Forge announced the first comprehensive line of butt-welding fittings.

Before the WeldELL line was introduced, the only available welding fittings were elbows. But in the WeldELL line came all the fittings needed to do a complete and workmanlike job of pipe welding . . . the tees, reducers, caps, stub ends, and welding flanges.

To produce all of these types of fittings in seamless forged steel was a giant undertaking—and still is. A good example of this is the line of reducers. Today there are 175 reductions in standard weight reducers alone—and this can be multiplied by all the weights and materials in which Taylor Forge reducers are available.

The first line is still the foremost line—the engineered line, the full value line. For up-to-the-minute facts about the WeldELL line, see your Taylor Forge Distributor.

TAYLOR FORGE

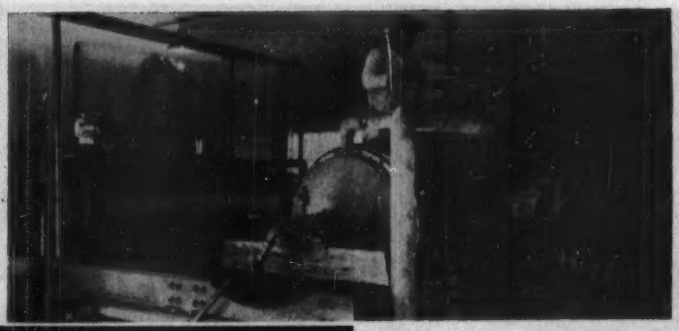
TAYLOR FORGE & PIPE WORKS

General Offices & Works • Chicago 90 • P. O. Box 485

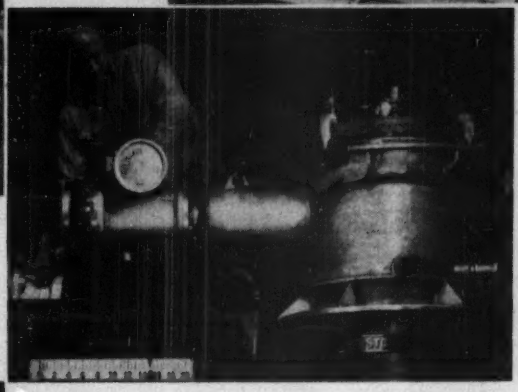
Plants at Carnegie, Pa., Fontana, Calif., Gary, Ind., Hamilton, Ont., Canada



Operator removes boxes of tubular paper capacitors from Stokes Vacuum Impregnator at Pyramid Electric Co., North Bergen, N. J. Capacitors have been impregnated with mineral oil to improve stability and lengthen service life.



Installation of Stokes Rotary Vacuum Dryers used by Metals Disintegrating Co., Berkeley, California, for drying of aluminum powder. Highly oxidizable materials can be handled without any danger of combustion or explosion when processed in vacuum.



Operator transfers evacuated retort from heating to cooling station of Stokes Vacuum Annealing Furnace, built for processing, annealing and other heat treatment of titanium, zirconium, hafnium and copper.



Operator loads shell-frozen human blood plasma into one of the Stokes drying chambers of the lyophilizing plant at the Sharp & Dohme, Inc. biological laboratories, Glenolden, Pennsylvania.

There is no romancing about Vacuum at Stokes!

Vacuum processing starts with a vacuum-tight system and pumps to exhaust the air.

These are simple truths, the significance of which is never forgotten among men who have worked for many years in vacuum engineering.

Stokes men have many years of *engineering* experience, *shop* experience, *operating* experience in the design, construction and installation of vacuum processing systems.

But the absence of romancing in Stokes' thinking implies no want of imagination! Indeed, the practical application of vacuum processing—which gives us blood plasma, the "wonder drugs", costume jewelry, diesel locomotive motors, radio and electronic communication—had much of its inception in Stokes laboratories; takes practical shape in Stokes vacuum processing equipment for industry.

Stokes is FIRST in Vacuum . . . in great and small industrial plants, in schools, hospitals, and laboratories throughout the world.

F. J. STOKES MACHINE COMPANY, PHILADELPHIA 20, PA.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment



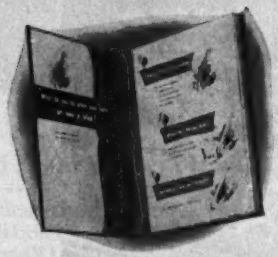
with Veelos on your machines...

v-belt replacement takes up to 90% less time

Actual in-plant records prove that Veelos v-belt can be installed *and operating* in up to 1/10th the time regularly needed to do the same job using endless v-belts.

Matched sets of Veelos are quickly made up in your own stockroom or at the machine by just coupling the correct lengths for the particular drive. Even outboard bearing drives are no problem. You *never* remove these outboard bearings, because Veelos is installed by simply coupling it around the shafts and running it onto the sheaves. And maintaining adequate stocks of Veelos is practically automatic. A quick check of the Veelos 100-foot reel will tell the inventory story.

For full vibrationless power delivery, for fast adjustability to keep sets matched, for ease of controlling inventory and for quick, simplified replacement — standardize on Veelos.



Have you seen this Veelos Facts Book?

Your Veelos v-belt distributor's salesman will be glad to give you a quick trip through this fact-packed, 36 page book. You'll find it well worth the few minutes it takes. Next time the salesman calls, ask him to show it to you.

VEELOS
THE LINK
V-BELT

Write for a copy of the VEELOS DATA BOOK. It's fully illustrated and packed with useful engineering data. We'll be glad to send a copy along and you'll be glad to have it!

MANHEIM MANUFACTURING AND BELTING COMPANY
602 Manbel St., Manheim, Pa.



ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

WOLVERINE TUBING *Plain*



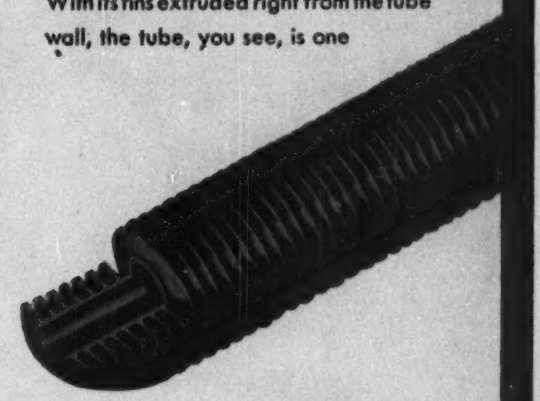
Wolverine tube possesses the greatest measure of *long-life-quality* that expert skill and years of experience can ever put into any tube.

And to make sure you will ultimately realize from your installation all the potential that Wolverine tube can supply, we suggest you ask our Customer Engineering Service to give you further assistance in the selection of tube of the proper alloys that will best meet your particular operating conditions.

Some of the most popular alloys: copper, cupro-nickel, brass, red brass, 70-30 brass, Muntz metal, aluminum and electric welded steel.

WOLVERINE TRUFIN* *Finned*

Trufin is a unique finned tube distinguished by its integral fin construction. With its fins extruded right from the tube wall, the tube, you see, is one



piece of metal, and consequently cannot be affected by vibrations or sudden temperature changes.

Nominal sizes range from ⅜" to ¾" root diameter. Furnished with thick-walled plain ends to permit best assembly.

Alloys available: copper, cupro-nickel, red brass, admiralty, aluminum, aluminum-brass, SAE 1010 steel, and stainless steel.

*REG. U.S. PAT. OFF.

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

If you will attend the Inform-A-Show at Los Angeles, May 24-26, stop in our Booth 304

WOLVERINE TUBE DIVISION

of CALUMET & HECLA, INC.

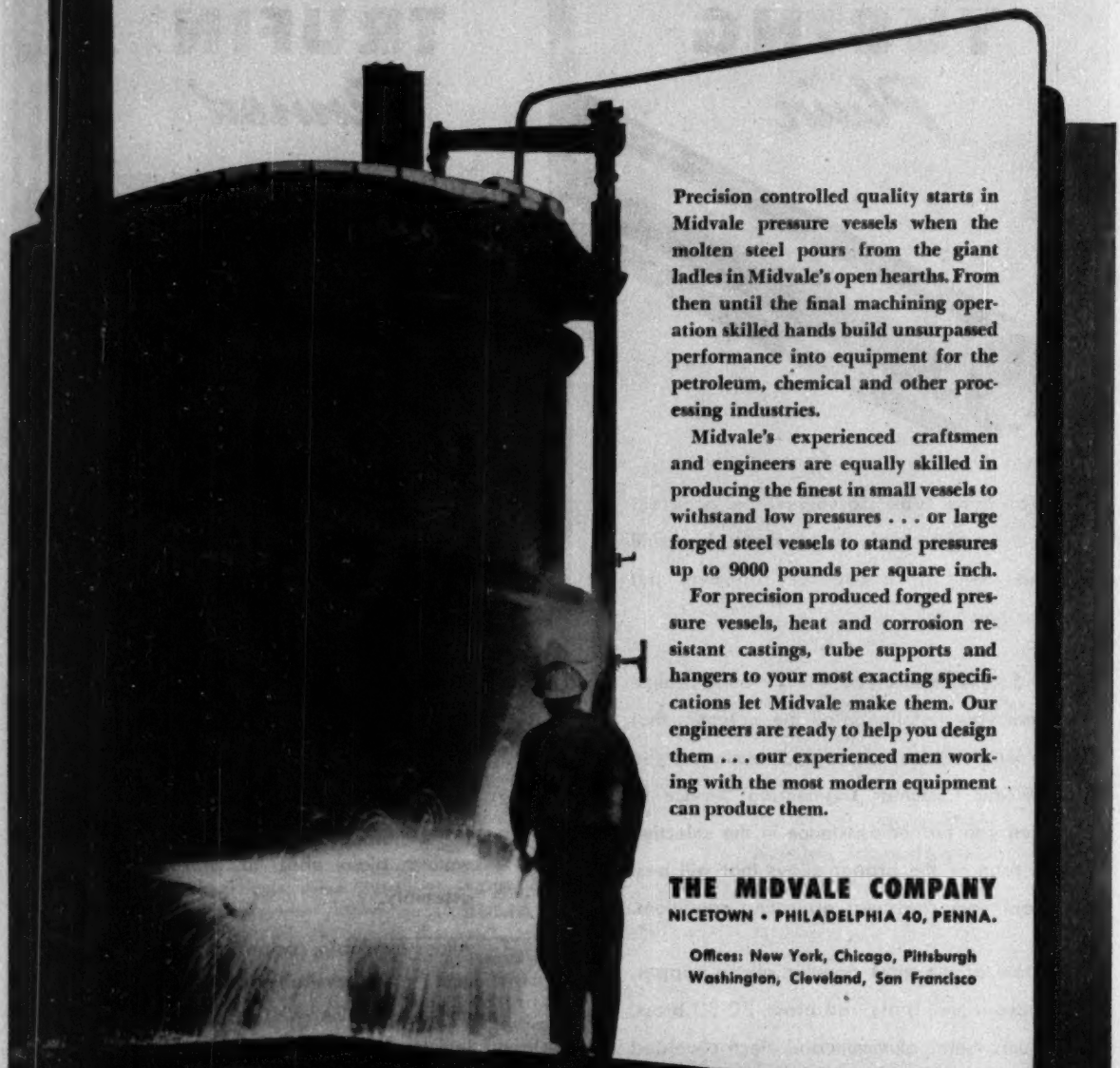
Manufacturers of Tubing Exclusively

1427 CENTRAL AVENUE • DETROIT 9, MICHIGAN

ESTABLISHED 1916

Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

PRECISION PERFORMANCE of PRESSURE VESSELS STARTS HERE



Precision controlled quality starts in Midvale pressure vessels when the molten steel pours from the giant ladles in Midvale's open hearths. From then until the final machining operation skilled hands build unsurpassed performance into equipment for the petroleum, chemical and other processing industries.

Midvale's experienced craftsmen and engineers are equally skilled in producing the finest in small vessels to withstand low pressures . . . or large forged steel vessels to stand pressures up to 9000 pounds per square inch.

For precision produced forged pressure vessels, heat and corrosion resistant castings, tube supports and hangers to your most exacting specifications let Midvale make them. Our engineers are ready to help you design them . . . our experienced men working with the most modern equipment can produce them.

THE MIDVALE COMPANY
NICETOWN • PHILADELPHIA 40, PENNA.

Offices: New York, Chicago, Pittsburgh
Washington, Cleveland, San Francisco

MIDVALE

Custom Steel Makers to Industry

PRODUCERS OF FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS



SLASH PUMPING "down time!"

You slash pumping "down time"—when you have a pump that requires minimum maintenance . . . when the parts are easily accessible when maintenance is necessary . . . when you have a Fairbanks-Morse Split-Case Centrifugal Pump!

See how easily this sturdy pump is inspected . . . lift the split casing and the entire rotating element can be removed without disturbing driver or pipe connections . . . even the bearings can be removed without use of a bearing puller!

See your Fairbanks-Morse Branch Pump Engineer on this Split-Case Single-Stage Centrifugal and the rest of his complete pump line. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY
RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

Reprinted from ***THE OIL DAILY, February 18, 1953.***

Keith Fanshier

FROM NOW ON

TIME WAS in the petroleum industry when volume was the controlling factor in net profit. A volume increase would cure almost anything.

The industry was expanding rapidly. Costs were moderate. By a little ingenuity here and there cost increases could be offset. There was breathing-space.

Times have changed. Costs everywhere have soared, alarmingly. Prices of what the industry has to sell have been held down since wartime by government controls and by probably the most severe competition existing in any industry.

That easy breathing-space no longer is there. Things are tight, all along the line.

• • •

In these circumstances, volume alone is no longer the answer. No more can inherently unsound operations be cured or glossed over by an increase in volume. Larger volume in an unsound situation now will only complicate conditions.

Now even more than ever, for instance, will price wars accomplish nothing—nothing but waste, loss, worry and misery for participants, a reproach upon the industry, and a lower standard of service to public and nation. Also a lower "standard of living" for the oil industry.

The members of this oil industry are in a battle of survival with their costs. A pity of it is that some seem not to recognize the fact, or perhaps even don't know the true meaning of the term: costs.

One thing is sure: cost-consciousness will pay off in this year 1953. That's true of every single operation from the gleam in the eye of a geologist on a mountainside to the cut-off of the hose nozzle in the motorist's tank.

• • •

That should make possible a fair, compensating price structure. That will give this industry a reasonable profit, the public dependable service, the nation a fine contribution to security.

Who says costs are not important? They are this important. Their recognition and recovery is just about the most urgent problem this industry faces this year, and for a long future, if it wants to continue being an industry.

From now on it will take more than volume.

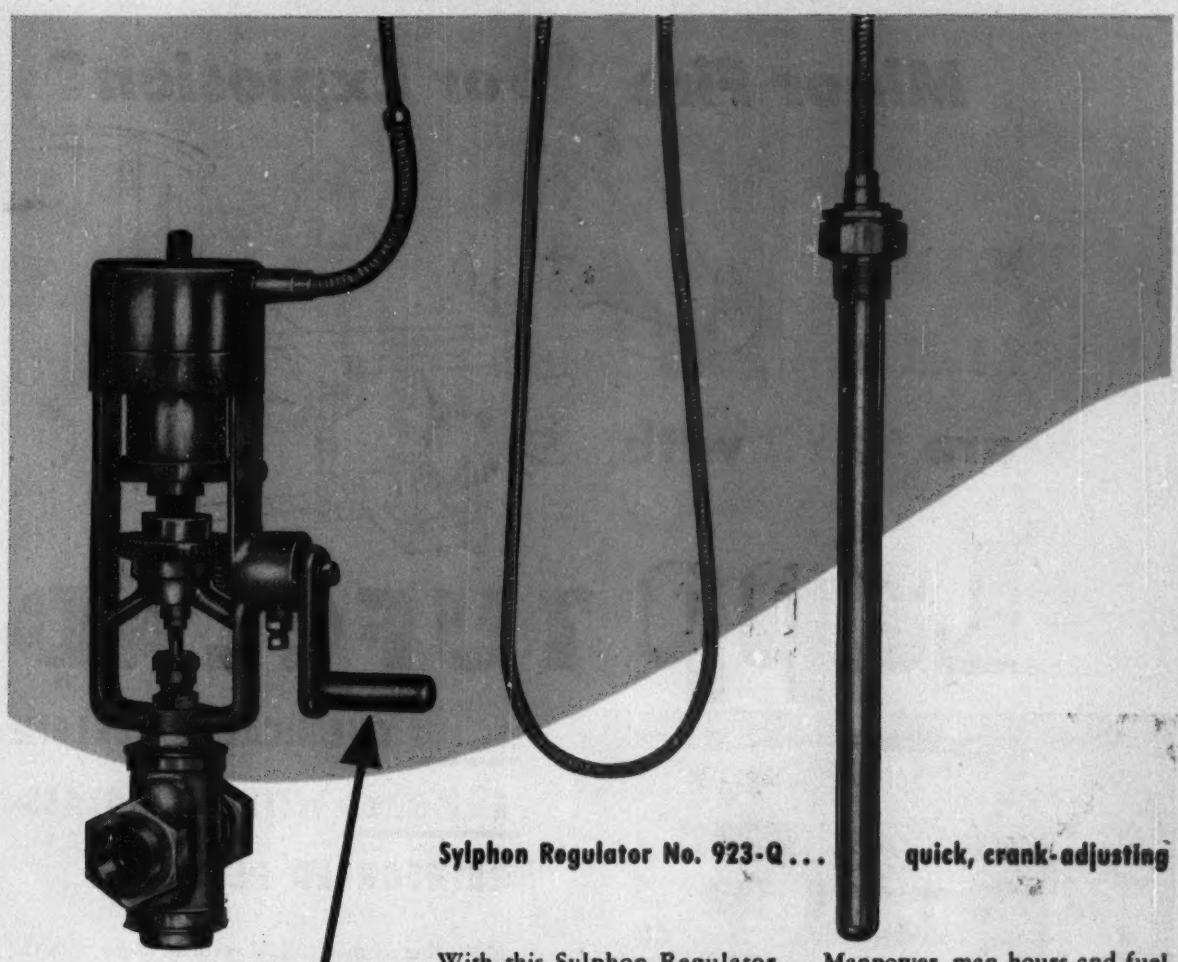
One of the most dramatic sources of economy in modern processing practice is the Ljungstrom Air Preheater. For details, consult The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

60 East 42nd Street

New York 17, N. Y.

Wherever you burn fuel, you need Ljungstrom



Sylphon Regulator No. 923-Q . . . quick, crank-adjusting

MAKES TEMPERATURE TO ORDER . . . FAST!

With this Sylphon Regulator, you can make quick changes in process temperatures—control operations faster and better. A simple turn of the crank adjusts the temperature to the setting desired. It's much easier and more accurate than conventional hand-wheel type regulators, especially for batch processing.

You get *more* advantages with this Sylphon Regulator. Because it provides dependable, accurate temperature control, you are assured of uniform processing conditions. Wasteful overheating is prevented. Spoilage is reduced. Manpower, man hours and fuel are saved.

Sturdy, neat and compact, No. 923-Q is built to give you years of trouble-free, reliable service. Used with open and closed tanks, bottle washers, glue kettles, dish-washing machines, slashers and other processing units. Ideal as standard equipment.

Write for information about Regulator No. 923-Q—or about other Sylphon Regulators that meet temperature control requirements for any industrial need. Ask for Catalog JC-A.



FS

FIRST WITH BELLOWS

Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON DIVISION

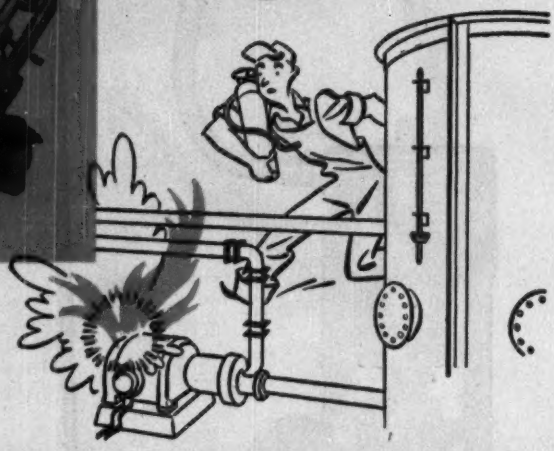
ROBERTSHAW-FULTON CONTROLS CO., KNOXVILLE 4, TENN.

Canadian Representatives, Darling Brothers, Montreal

Minor Fire or Explosion?



YOUR LINES are SAFE with



Lapp TUFCLAD®



Angles and Angle Valves (in sizes to 6"), safety valves, flush valves, plug cocks, are available in Lapp solid porcelain with TUFCLAD armor. Also pipe and fittings (to 8") and a variety of special shapes.

SOLID CHEMICAL PORCELAIN ARMORED WITH FIBERGLASS-REINFORCED PLASTIC

Now there's mechanical security to go with the chemical purity and corrosion-resistance of solid Lapp Chemical Porcelain. TUFCLAD armor is the answer—multiple layers of strong Fiberglass fabric impregnated and bonded to the body with an Epoxide resin of high strength and chemical resistance. It serves as an insulator against thermal shock—a cushion to accidental impact. And it is itself *tough* and strong, able to hold operating pressures against gross leakage even if porcelain is cracked or broken. Provide this protection to your personnel, equipment and product.

WRITE for description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 704 Maple St., Le Roy, N. Y.

Lapp

PROCESS EQUIPMENT

CHEMICAL PORCELAIN VALVES • PIPE • RASCHIG RINGS

PULSAFEEDER CHEMICAL PROPORTIONING PUMPS

Put WASTE HEAT to WORK!

Servel changes a dead loss into valuable PROCESS COOLING *and* AIR CONDITIONING

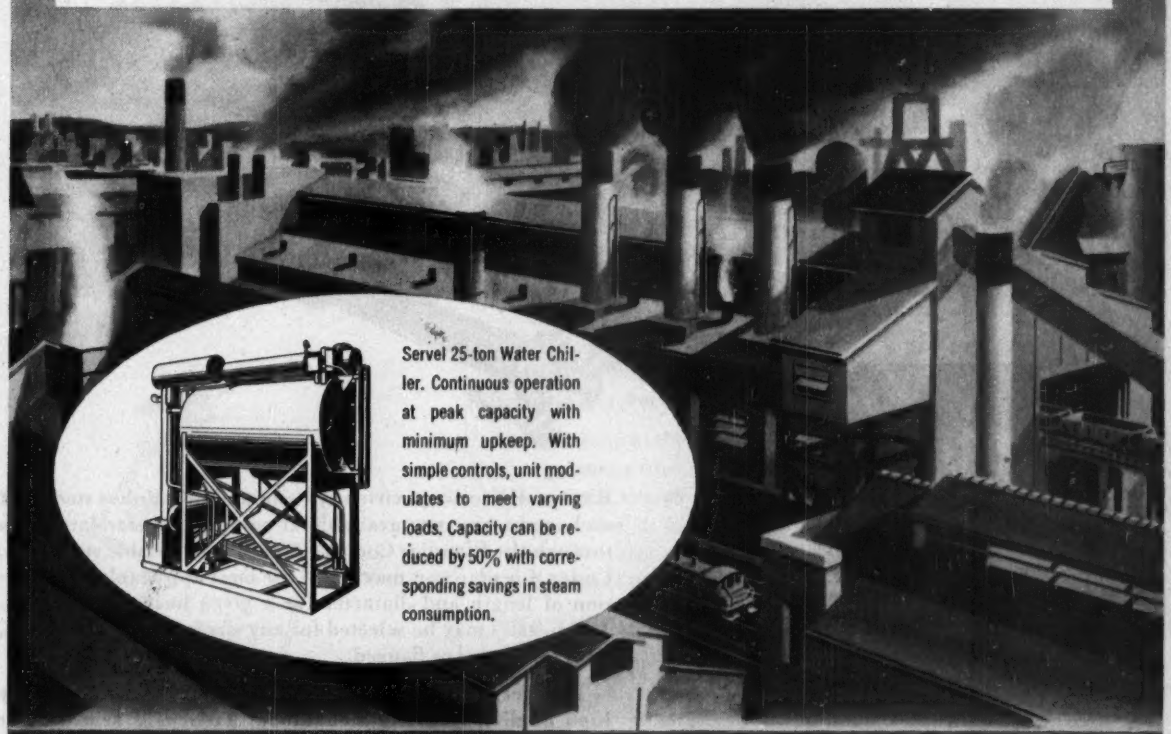
● If there's a need in your plant for air conditioning, process cooling, or industrial precooling, there's most certainly a place for a Servel Water Chiller.

These highly efficient units are powered by steam from any source. Many plants have found that *waste heat is readily turned to this use.*

Consider, too, the advantages beyond the availability and low cost of energy. Servel Water Chillers employ the time-proved absorption principle of refrigeration that *eliminates moving parts.* Water is used as the refrigerant. No compressors!

Compact size, quiet, vibration-free operation, and low floor loading make possible single or multiple installations in practically any location. Simple and economical piping arrangements are possible. In many air-conditioning installations for large buildings, duct systems can be eliminated entirely.

Servel Water Chillers are available in capacities for many types of *load. All carry a full 5-year warranty!* Contact your Servel dealer, or mail coupon for details and engineering help on your problems.



Servel 25-ton Water Chiller. Continuous operation at peak capacity with minimum upkeep. With simple controls, unit modulates to meet varying loads. Capacity can be reduced by 50% with corresponding savings in steam consumption.

Servel

the name to watch for great advances in

AIR CONDITIONING ✓ REFRIGERATION

SEND NOW FOR DETAILS!

SERVEL, INC., Dept. CE-5, Evansville 20, Indiana

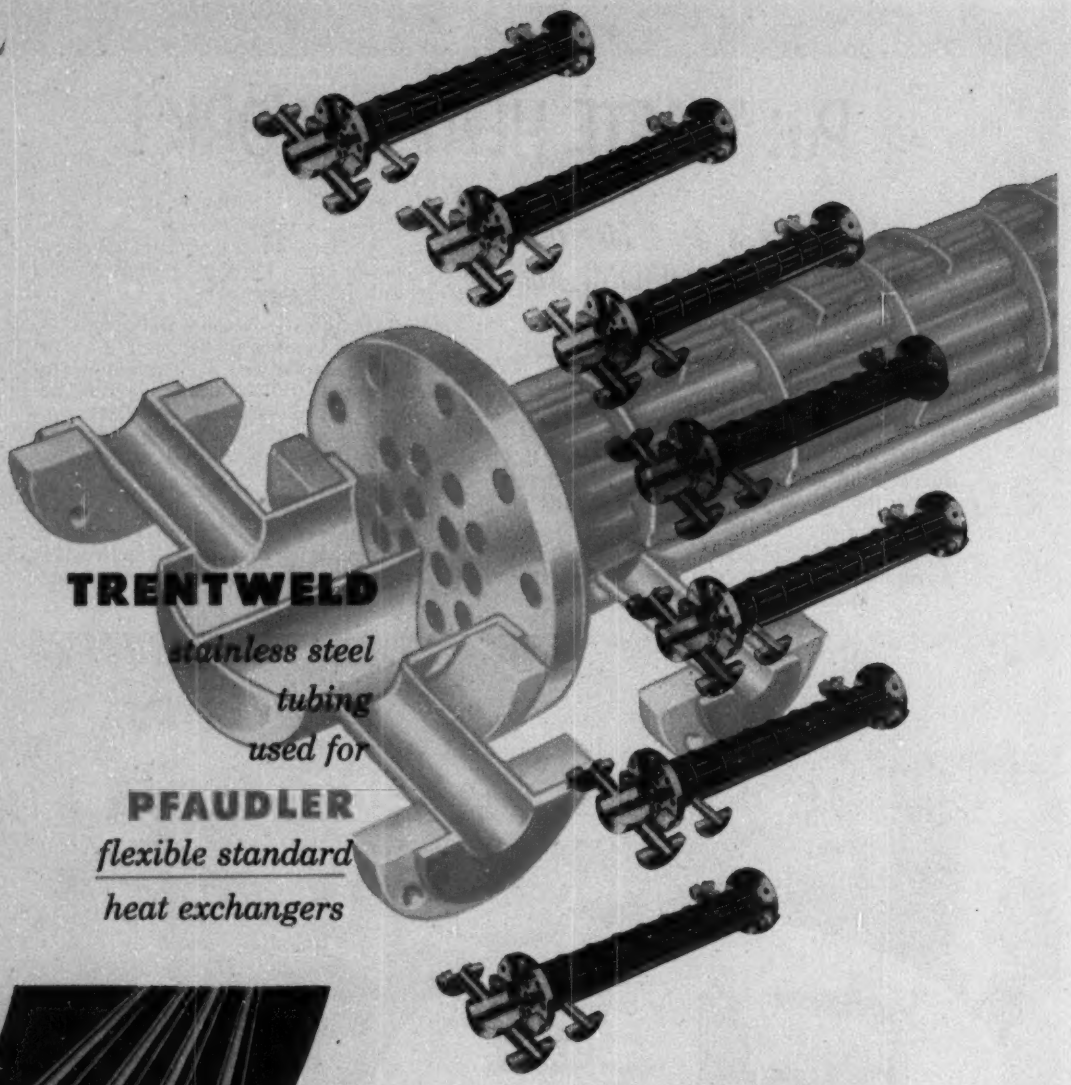
Send me further details on Servel equipment for air conditioning, process cooling and industrial precooling.

Name_____

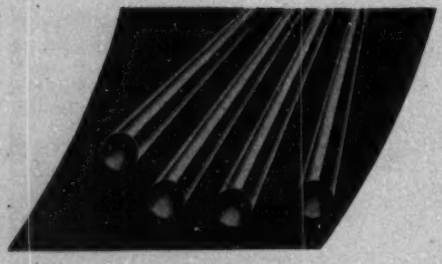
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City_____ Zone____ State_____



TRENTWELD
stainless steel tubing used for
PFAUDLER
flexible standard heat exchangers



Prompt deliveries of virtually custom built stainless steel heat exchangers are now available at competitive standard costs through the Pfaudler Company's system of flexible standards. Under this plan you may select the most applicable combination of length and diameter for a given heat transfer area. And nozzles may be selected for any size and in any position, either threaded or flanged.

To meet Pfaudler's varied and exacting requirements for high quality stainless steel tubing, Trentweld is used. For Trentweld Stainless Steel Tubing is made by tube specialists who roll and weld stainless and high alloy tubing, exclusively.

You're sure to find a TRENTWELD tubing that will meet your needs. It's available in sizes from ⅛" to 40" OD, and in a wide range of grades, gauges and finishes. Our engineers have had broad experience in solving tubing problems in many different industries. So if you have a problem involving stainless or high alloy tubing, write to us today and let us help you solve it.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

Sulphur



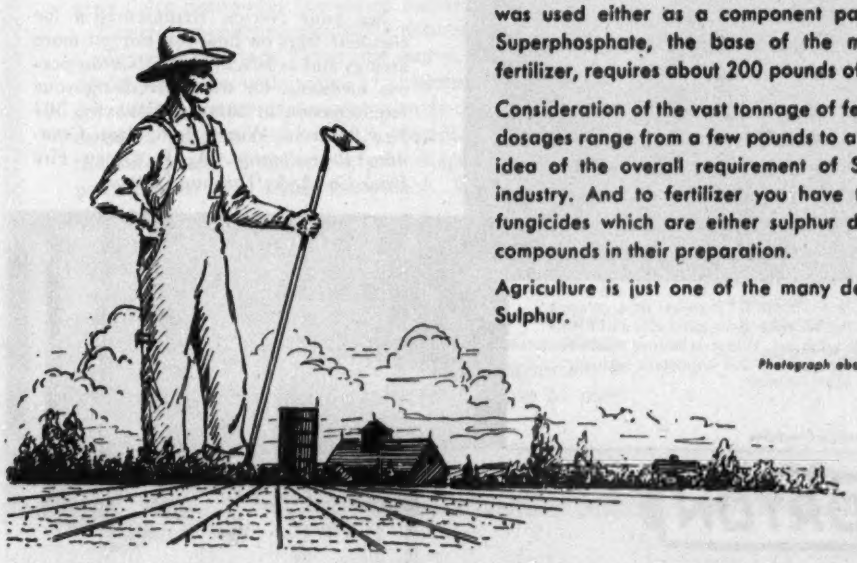
Thousands of tons mined daily, but where does it all go?

THE DEPARTMENT OF AGRICULTURE reports that in 1950 some 336,000,000 acres of land in the United States were under crop cultivation. That's a lot of acreage.

But where, you might ask, is the connection with Sulphur? Fertilizer, to take just one phase of agriculturally-used chemicals in which Sulphur was used either as a component part or as a processing element! Superphosphate, the base of the most widely used manufactured fertilizer, requires about 200 pounds of Sulphur for every ton produced.

Consideration of the vast tonnage of fertilizer used in agriculture — and dosages range from a few pounds to a ton or more per acre — gives an idea of the overall requirement of Sulphur for this one division of industry. And to fertilizer you have to add all the insecticides and fungicides which are either sulphur derivatives or have used sulphur compounds in their preparation.

Agriculture is just one of the many destinations of great tonnages of Sulphur.

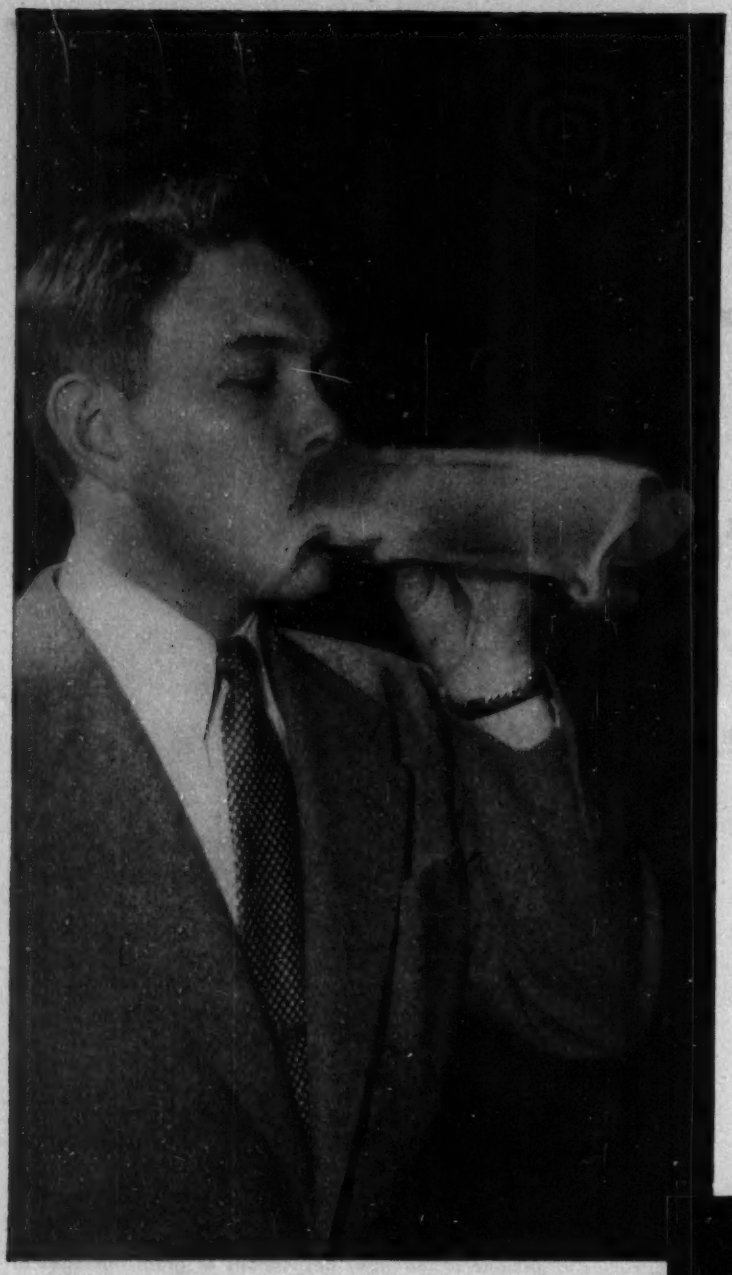


Photograph above shows our loading dock at Galveston, Texas

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

Mines: Newgulf and Moss Bluff, Texas



SMOKE BLOWN THROUGH a Norton ALUNDUM* *seamless* tube escapes throughout the tube's entire area. Such a tube gives most efficient filtration and ease of cleaning by back washing. When selecting tubes for your specific application be sure they embody this important feature.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Why Norton seamless tubes give you better filtration

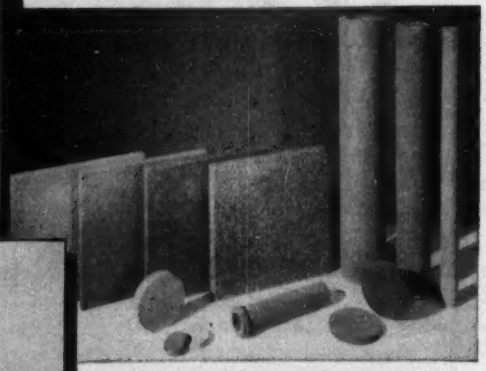
Only Norton ALUNDUM tubes have the seamless construction that means more uniform filtration and enables faster, more thorough cleaning. And like all Norton porous mediums they're made with the patented *controlled structure* process that assures even distribution of pores — in the size and open-pore ratio that best meets your needs.

Cost-cutters over a wide job range

In any form, Norton porous mediums have exceptional resistance to breakage, chipping and acid and alkaline conditions. They're designed to perform better, last longer and cut your operating costs in a wide variety of chemical field applications. For example: filtering water or solvents . . . cutting oils, wine and other liquids . . . reclaiming cleaning fluids and industrial waste . . . in boiler feed water treatment.

Get the whole story

See your Norton Representative for complete facts on how you can get more savings and satisfaction with Norton porous mediums. Or write describing your requirements, to NORTON COMPANY, 504 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



NORTON ALUNDUM POROUS MEDIUMS are available as tubes, plates and discs in a wide range of sizes.

NORTON

POROUS MEDIUMS

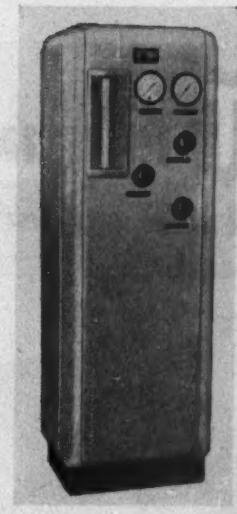
Making better products to make other products better

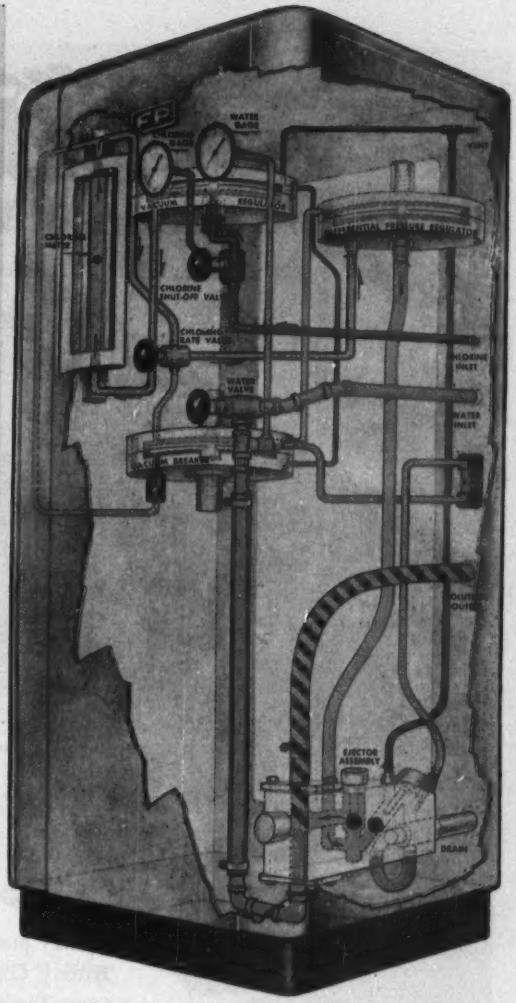
NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

new

RATOCHLOR 1050

CHLORINE DISPENSER





every inch corrosion resistant

From cabinet to valves, every part of the new Ratochlor unit is as corrosion resistant as modern science and technology can make it, the result of years of field and laboratory tests in the handling of both dry and moist chlorine gas.

The complete outer cabinet is made of a new polymer-impregnated fibre glass material, whose attractive grey color permeates the entire material.

Control operations inside the cabinet center around a corrosion resistant Flowrator meter, which provides direct, accurate, wide range of chlorine flow rate. New corrosion resistant materials recently developed in the research laboratories make it possible to incorporate the safety and simplicity of the diaphragm-regulator principle in the 1050 Ratochlor. Water seals are eliminated.

The design of the new 1050 Ratochlor provides the fullest control of chlorine solutions, the most advanced materials and methods to combat corrosion. It can be readily adapted for program control, proportioning and remote control. A complete and comprehensive discussion of the new 1050 Ratochlor and its operation is available in booklet form. Write for Catalog 61 now.

CHECK THESE ADVANTAGES

- SAFETY
- complete corrosion resistance — using Uscolite, Teflon Kel-F, Tantalum and other materials
- direct, visible flow measurement
- maximum water economy
- dependability — minimum working parts
- solution feed standard (gas feed available)
- constant vacuum
- manual rate adjustment

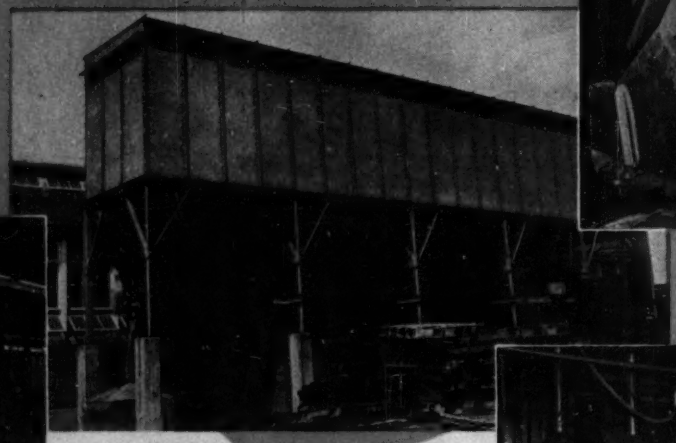
FISCHER & PORTER CO.

550 County Line Road

Hatboro, Pennsylvania, U.S.A.

HOW DUST IS ELIMINATED

in the manufacture of Exide batteries



View of the Dustube Collector for recovery of lead dust.



View of a plate trimming saw.



This refining kettle and dross collection unit are ventilated by the Dustube Collector.



Four of the battery plate brushing machines. Note hooding for corraling all dust created.



Battery plate cleaning and trimming operations at The Electric Storage Battery Company's Chicago plant created manifold dust control problems. The number of processing stations involved and the characteristics of the dust—lead oxide—necessitated extensive hood designs to control the dust at its source and high efficiency collector equipment to salvage the valuable material.

The solution to the problem, as illustrated in the pictures above, consists of adequate hooding at the dust creating stations plus a large Dustube cloth tube type Collector. Results have been "highly satisfactory" according to plant officials. Working areas are clean and healthful. The lead oxide is recovered in the dry state and is handled without de-watering, drying or other processing.

The Dustube Collector has an unusual flexibility in handling dust or fume in all types of chemical processes. Its simple, practical design provides the highest efficiency at the lowest cost. Get the facts for your problem. *Write for Catalog No. 372.*

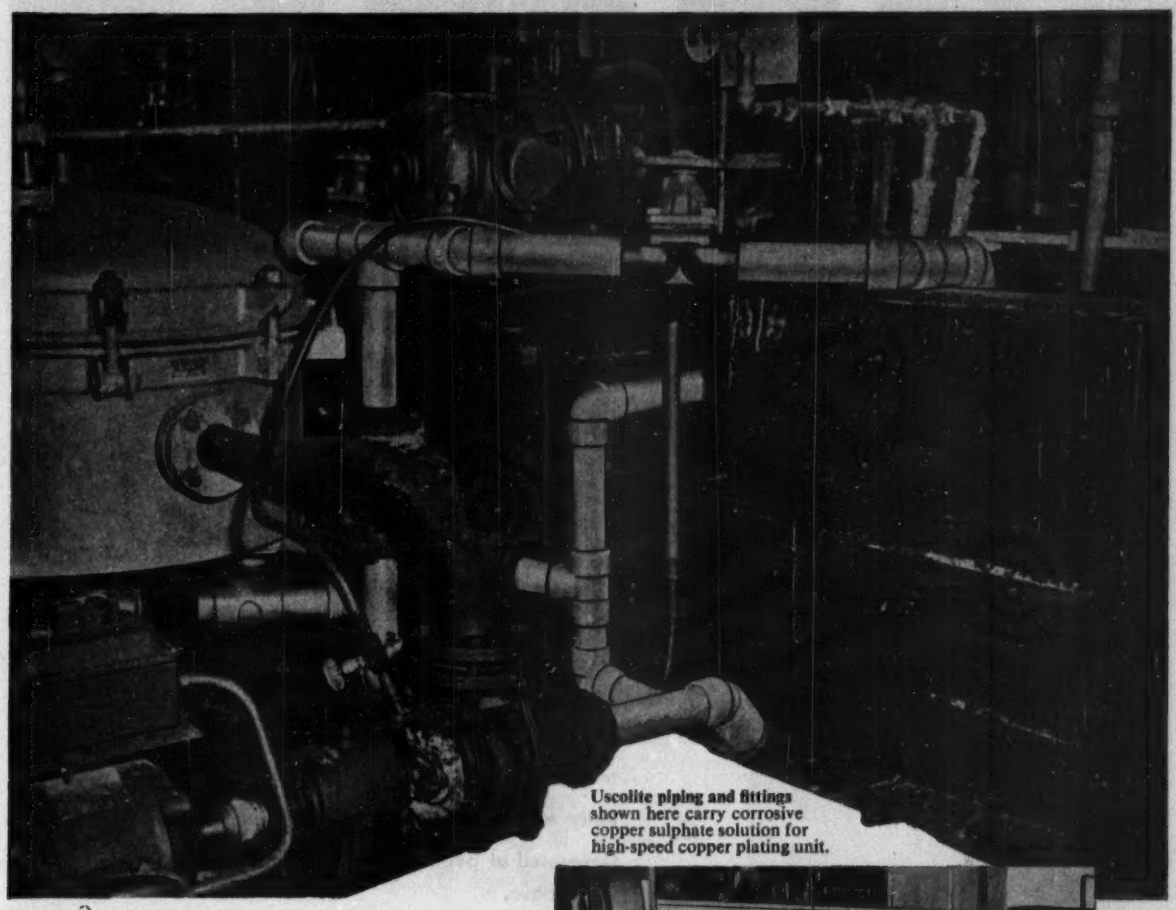
DUSTUBE ADVANTAGES

More Efficient Dust Removal
More Economical Operation
Reduced Maintenance Costs
Longer Cloth Life
More Thorough Shaking

American
WHEELABRATOR & EQUIPMENT CORP.
347 S. Byrkit St., Mishawaka, Indiana

dustube® COLLECTORS

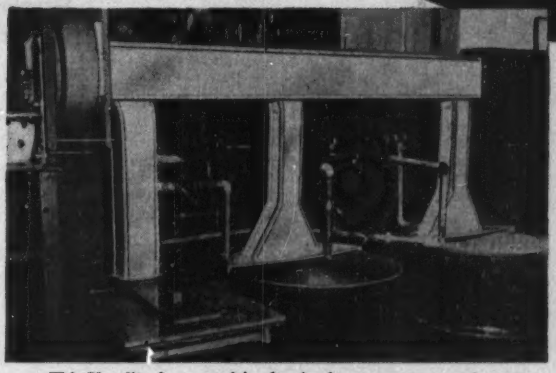
Hungry acids can't eat U. S. Uscolite® pipe



Uscolite piping and fittings shown here carry corrosive copper sulphate solution for high-speed copper plating unit.

A LARGE phonograph record factory needed a piping system which would stand up under the corrosive effects of acids. United States Rubber Company engineers were called in for consultation. They recommended piping, ducts and fittings made of Uscolite, the great "U.S." plastic . . . and the acids gave no more trouble.

Uscolite is resistant to *most* chemicals, acids and alkalies. It has amazingly high impact strength, is easy to handle, can be cut to length and threaded on the job. If you have any difficulties with piping, you can't afford to overlook Uscolite. Call any of our 25 District Sales offices (each is staffed with engineers) or write to address below.



This Uscolite duct, used in the de-chrome room, carries away fumes from a 50% hydrochloric solution at 160 degrees F. The factory also uses U.S. Steam Hose and U.S. Transmission Belts.

U.S. RUBBER

"U.S." Research perfects it
"U.S." Production builds it
U.S. Industry depends on it

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Grinding Wheels • Packings • Tapes • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

Q.E.D.

If you remember your mathematics, "Q.E.D." means "which was to be proved." With Welsbach Ozonators, "Q.E.D." stands for Quality, Economy and Dependability. The long life and quality built into this equipment... the economy and dependability of Welsbach Ozone... "which was to be proved"... has been proved where Welsbach Ozone has been used as an oxidant in installations ranging from chemical processes to treatment of industrial wastes to water purification.

On the basis of cost, of convenience, of rate of reaction, of yield or of freedom from extraneous substances, Welsbach Ozone is the outstanding chemical oxidant.

It will pay you to look into the use of Welsbach Ozone—not on the basis of cost alone but with consideration of these extra advantages too:

Q.E.D.

No storage problem; no procurement problem; no materials handling.

Fully automatic. No complicated control problems.

Generated at point of use with equipment requiring little space.

No full-time supervision or labor required.

Constant, predictable operating cost.

"Q.E.D."

Write for information.

THE WELSBACH CORPORATION

OZONE PROCESSES DIVISION

1500 Walnut Street, Philadelphia 2, Pa.

Pioneers in Continuing Ozone Research



PUTTING AIR TO WORK FOR CARNEGIE TECH: Lead bricks and special fume exhaust equipment protect "Hot" lab technician from two hazards—direct radiation and contaminated air.

HOW TO TAME "HOT" AIR

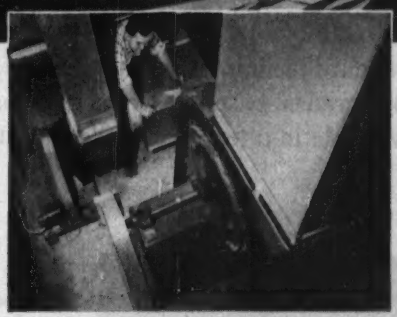
AROUND RADIOACTIVE MATERIALS

In the hand of the technologist is an awesome new tool—the radioactive isotope. But it is two-edged. With all its promise, it poses grave new problems in safety—including contamination of air by radioactive fumes, vapors and airborne particles.

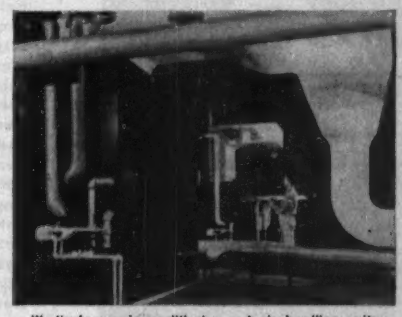
Control of dangerous air can be relatively simple, like the special laboratory hood and Westinghouse fume exhaust equipment shown here in the Chemistry Department at Carnegie Tech. In varying degree, the problem can be more complicated—like cooling the atomic pile at the Brookhaven National Laboratories. But for each case there's an effective answer.

For, long before the first reactor pile was built, Westinghouse engineers were studying and employing radioactive materials. In the Sturtevant Division this has culminated in a fund of knowledge and tested equipment for safe control of "hot" atmospheres.

If you are using radioactive materials, or for that matter if you have *any* air handling problem where it pays to be sure, check into Westinghouse equipment for air handling, air cleaning and air conditioning. Call the Westinghouse-Sturtevant office nearest you, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



Silentvane® Fans move the large volumes of air which are drawn from exhaust hoods quietly and positively.



Westinghouse air conditioning and air handling units help keep laboratory temperature and humidity constant.

YOU CAN BE SURE...IF IT'S Westinghouse

J-80250B

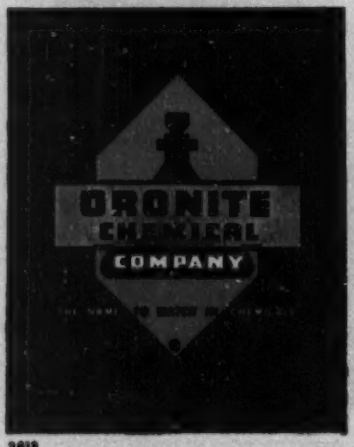
AIR HANDLING

INQUIRE ABOUT

Oronite POLYBUTENES

a versatile chemical widely used to improve products and performance at reduced raw material costs

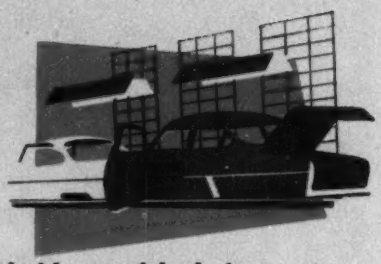
Properties: Polybutenes are nearly water-white chemically inert liquids of moderate to high viscosity and tackiness. They have excellent aging characteristics—do not become gummy or waxy and do not harden, darken or change in any essential property over long periods of atmospheric exposure. Polybutenes can be readily emulsified using standard techniques and equipment. They are available in four grades, based on viscosity. Complete information is available in a technical bulletin sent on request.



2019

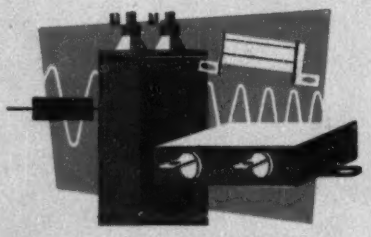
A partial list of Oronite Products

Detergent Alkane
Detergent Slurry
Detergent D-40
Detergent D-60
Dispersant NI-O
Dispersant NI-W
Wetting Agents
Lubricating Oil Additives
Cresylic Acids
Gas Odorants
Sodium Sulfonates
Purified Sulfonate
Polybutenes
Naphthenic Acids
Phthalic Anhydride
Ortho-Xylene
Xylol
Aliphatic Acid
Hydroformer Catalyst
Dispersant FO
(Domestic Fuel Oil Inhibitor)



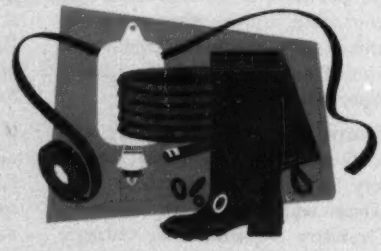
Ideal for sound deadening, insulation or calking compounds

Polybutenes are widely used in various insulating compounds by the automotive industry (1) to prevent rust and corrosion of metal chassis parts (2) to prevent rattles and squeaks as a "noise eliminator" between metal to metal surfaces. In the home appliance industry as an insulation compound medium against heat or cold. Compounds can be pigmented or used in natural color of the mineral filler.



Electrical properties outstanding

Oronite Polybutenes offer superior dielectric strength, low expansion coefficient and low power factors essential in paper-insulated electrical products. Because of their low power factor values over a wide frequency range, they are useful as a dielectric in condensers and capacitors. Accelerated aging tests show the great stability of this power factor over long periods of time. Their compatibility with many synthetic rubber and rubber-like polymers permits ready compounding for flexible insulations.

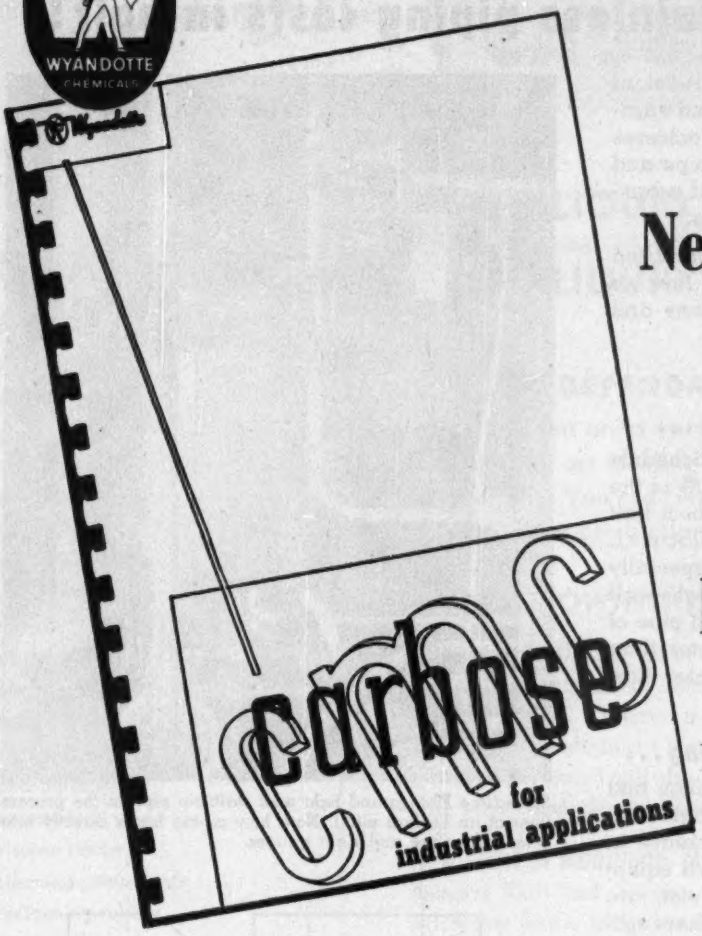


Economical extender of rubber

Polybutenes can be used as a rubber extender in the manufacture of rubber boots, garden hose, hot water bottles and a host of other molded rubber products. Besides extending rubber, Polybutenes plasticize the mass of rubber making it more pliable for easy milling. Polybutenes are also used in milling up reclaimed rubber batches and have a field of usefulness in plasticizing various synthetic rubber latices.

ORONITE CHEMICAL COMPANY
38 SANSOME STREET, SAN FRANCISCO 4, CALIFORNIA
30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK
STANDARD OIL BLDG., LOS ANGELES 15, CALIFORNIA
600 S. MICHIGAN AVENUE, CHICAGO 5, ILLINOIS
MERCANTILE SECURITIES BUILDING, DALLAS 1, TEXAS

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New CMC grades for paper, lithography, laundry sizing!

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Information on:

- Preparation of solutions
- Textile applications
- Paper and printing applications
- Laundry and sizing applications
- Ceramic, water-paint, well-drilling and other applications

Send for this booklet today!

Two recent additions to Wyandotte's CARBOSE* series, CARBOSE VL and CARBOSE LS, broaden still further the industrial applications of versatile sodium carboxymethylcellulose.

CARBOSE VL, an extremely low-viscosity sodium CMC, has shown excellent results when applied to paperboard at the calender stack. In lithography, the maximum solubility and non-gelatinizing characteristics of CARBOSE VL make it a superior product for desensitization of zinc plates.

Developed especially for sizing in the home laundry, CARBOSE LS does not readily scorch at the high temperatures common in ironing . . . provides excellent softness of finish and retention of shape on wearing without uncomfortable stiffening of the fabric.

Other CARBOSE grades have proved excellent for detergency promotion, textile applications; ceramics, adhesives, water paints, well-drilling muds.

To find out how CARBOSE might help you, send for the new 40-page CARBOSE booklet. It gives full data, possible applications. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.* *REG. U.S. PAT. OFF.

Wyandotte CHEMICALS

The *Speedline* system may cut your stainless piping costs in half!

● Here is a new idea in corrosion-resistant piping that combines *important savings* and *engineering advantages.* The *Speedline* system achieves these results by using light wall stainless pipe and the versatile *Speedline* Fittings which speed assembly time and give you tight, leak-proof joints.

As one engineer said: "We started to use *Speedline* Fittings with light wall pipe to save money. Now we find that we also get better flow conditions and increased capacity in our lines."

Here's how the *Speedline* system works:

If you are now using Stainless Pipe . . .

. . . chances are that it is the conventional Schedule 40. But this heavy wall is not needed in 90% of the cases. Light wall Schedule 5 pipe costs about half as much, and all sizes will easily withstand 150 p.s.i. working pressures. *Speedline* Fittings are specially designed for fast, low-cost installation of light wall stainless pipelines. And because light wall pipe of the same size has a larger inside diameter than heavy pipe, you gain 15% to 25% greater flow and capacity!

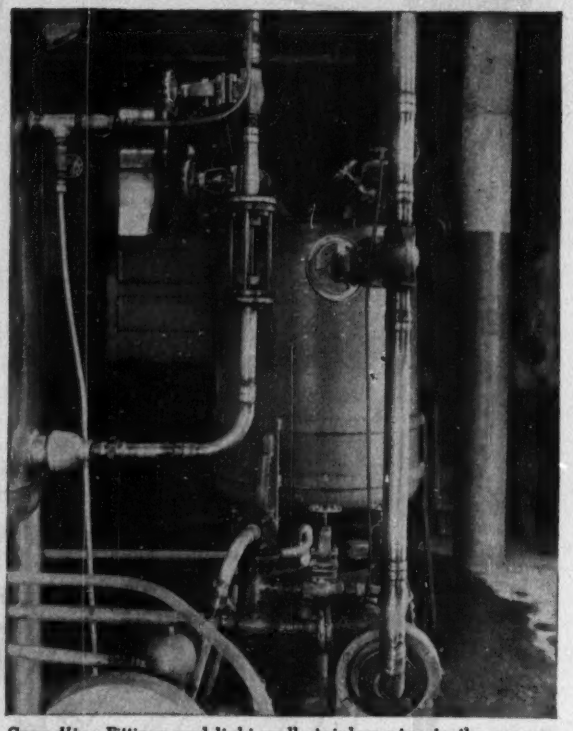
If you are now using Stainless Tubing . . .

. . . the *Speedline* system offers real savings and advantages. It permits you to change to a light wall *pipe* rather than *tubing* size—at no increase in cost. And here's where you gain. Standard equipment like valves, pumps, sight gauges, etc., are made in *pipe* sizes—you hook right in without special adapters! And equally important, *piping* permits you to use the next lower dimension (for example, 1" Sch. 5 pipe has even greater capacity than 1¼" O.D. tube). This means that you can use smaller valves, flanges, and other accessories—an entire installation would be considerably lower in cost.

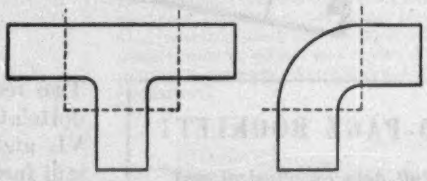


WRITE FOR THIS FREE BOOK

Just write a note on your company letterhead and we will mail the *Speedline* catalog to you. It shows why you get better results at less cost with *Speedline* Fittings.



Speedline Fittings and light wall stainless pipe in the process lines of an Eastern plant. Note how piping hooks directly into standard valves and sight gauges.



Look for the "Tangential Feature"

These drawings show a *Speedline* Tee and 90° Elbow. The dotted lines show the termination points of conventional fittings. The additional straight section of *Speedline* Fittings permits attaching of unions or flanges without fouling, reduces the number of welds required, and eliminates troublesome curved or angle joints. The tangential feature is common to all *Speedline* Fittings such as Ells, Tees, Crosses, etc.

Speedline distributors are located in principal cities from coast to coast

Speedline **Corrosion-Resistant FITTINGS**

—the newest thing in pipeline economy

Manufactured by **HORACE T. POTTS CO.** • 500 E. Erie Avenue • Philadelphia 34, Penna.

Hooker Chemical Guide
(ONE OF A SERIES)
USE this handy reference to save time in selecting high quality chemicals.

HOOKER CAUSTIC SODA

50% LIQUID	**FLAKE**
73% LIQUID	**SOLID**

Used in these products and processes:

wood pulp
soap
glass
chemical intermediates
phenol
resorcinol
naphthol
oxalic acid
indigo
sodium salts
pigments
aniline dyes
ceramics
pharmaceuticals
cosmetics
viscose rayon
cleaning compounds
reclaiming rubber
mercerizing cotton
reclaiming tin
food processing
reclaiming paper
metal ore refining
bleaching textiles
petroleum refining
dyeing textiles
engraving
printing textiles
lithography
water softening
and many, many others

DEPENDABLE DELIVERIES

When you order chemicals from Hooker, you know that you are dealing with a reputable, dependable supplier. You can count on prompt deliveries, timed to fit your production schedule.

GROWING...TO SERVE YOU BETTER

New Chicago Office—To better serve Midwestern chemical users, Hooker has recently opened an office at 1 North LaSalle Street in the heart of Chicago's Loop. Midwestern users need only call Chicago, CEntral 6-1311, to receive fast shipment from the main plant at Niagara Falls. Hooker technical personnel will also be stationed at the Chicago office to assist you with your chemical requirements.

New plant at Montague, Michigan—In addition to the existing plants at Niagara Falls and Tacoma, Hooker is building a plant at Montague, Michigan which will increase chlorine and caustic soda production by 100,000 tons per year. Construction will be completed in 1953. This plant will further speed deliveries to Midwestern users.

Research and development—Over 100 regular products, and many more research products, have been made available through Hooker's specialized experience in chlorination, hydrogenation, esterification, sulfhydration, hydrochlorination, and fluorination. Complete laboratory and pilot plant facilities are ready to serve you.

Products available now—Chlorine, muriatic acid, sodium sulfide, chlorobenzenes, and many other products are available for immediate shipment. For full information, write on your letterhead to *Hooker Electrochemical Company*, 5 Forty-Seventh Street, Niagara Falls, N. Y.

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY
NIAGARA FALLS • TACOMA • NEW YORK • CHICAGO • LOS ANGELES

HOOKER CHEMICALS



For uniform purity in every shipment... specify HYSTRENE® fatty acids

PURITY:

Hystrene hydrogenated fatty acids are exceptionally pure . . . have lower percentages of unsaponifiables and unsaturates than other fatty acids.

UNIFORMITY:

strict control over manufacturing methods provides complete uniformity from shipment to shipment . . . from bag to bag.

COLOR STABILITY:

in every color test—heat exposure, potassium soap, sulfuric acid—you'll find that Hystrene has greater stability. This more stable color often eliminates the need for bleaching, distilling, and other color-improving processes in your manufacturing operations.

Whichever Hystrene type you use . . . Hystrene S-97 hydrogenated soya fatty acid, or Hystrene T-70 hydrogenated tallow fatty acid . . . you'll get the utmost in quality every time. For complete technical details, write or call Atlas today.

HYSTRENE SPECIFICATIONS

	HYSTRENE T-70	HYSTRENE S-97
Titer (Average °C.)	61.5-62.5	65.5-66.5
Iodine Value (Wijs)	0.5 Max.	0.8 Max.
Unsaponifiables (%)	0.15 Max.	0.25 Max.
Color (Lovibond, 5¼" Cell)	2Y-0.4R Max.	3Y-0.7R Max.
Free Fatty Acid (as stearic—%)	100.5-102.5	100.0-101
Acid No. (Average)	198-202	195-199
Saponification No. (Average)	199-203	198-201

INDUSTRIAL CHEMICALS DEPARTMENT

ATLAS POWDER COMPANY

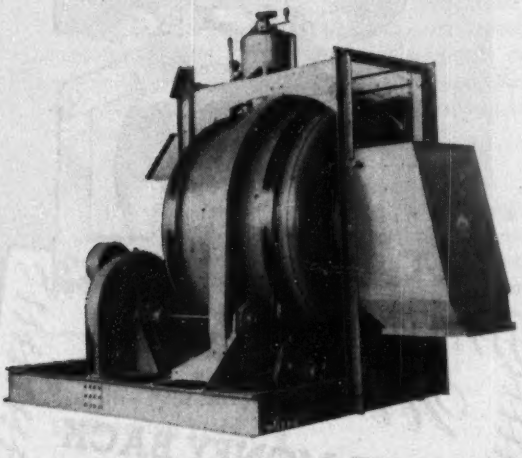
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offices in principal cities

ATLAS POWDER COMPANY, CANADA, LTD. BRANTFORD, CANADA



He can't stand that slow mixing cycle!



THE MODERN WORTHINGTON CHEMICAL MIXER is available in sizes up to 110 cu ft or 3 tons per batch. Each mixer is equipped with a measuring tank for various chemical applications.

But it isn't *that* bad, friend. Give us a chance to help. We've got a mixer that can boost your daily output as much as 10 per cent. It's the Worthington chemical mixer with an engineered blade design that gives you a mixing action faster than any we know of. It saves time with every batch, can be set up for continuous agitation, mixes thoroughly, and eliminates these other big problems as well:

CORRODED DISCHARGE CHUTE—The Worthington discharge chute is out of the mixer during mixing time. Proper balance makes manual control of chute easy. Pneumatic controls are also available.

WOBBLY DRUM ROLLER—Worthington drum rollers are of genuine carwheel metal, ground to close tolerances. Drum roller shafts are easily adjustable to compensate for wear.

HEAVY HORSEPOWER CONSUMPTION — Worthington's specially engineered, anti-friction construction assures peak operating efficiency with lowest possible horsepower consumption.

YR.3.2

WORTHINGTON

Industrial Mixers

SEND THIS COUPON TODAY to learn more about how to reduce mixing time and cost with a Worthington chemical mixer. There's a skilled Worthington engineer near your plant. At your request, he'll be glad to call on you.

Worthington Corporation
Industrial Mixer Division
Plainfield, New Jersey

B

Name .....

Position .....

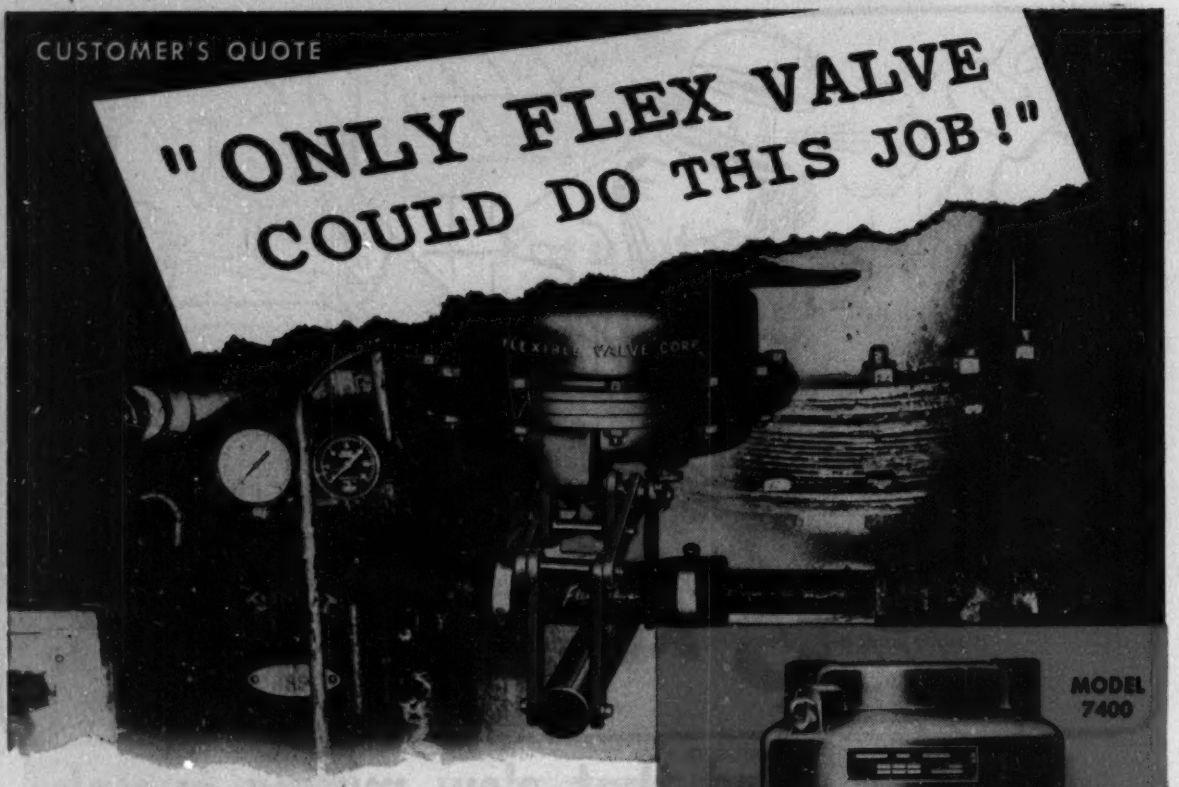
Address .....

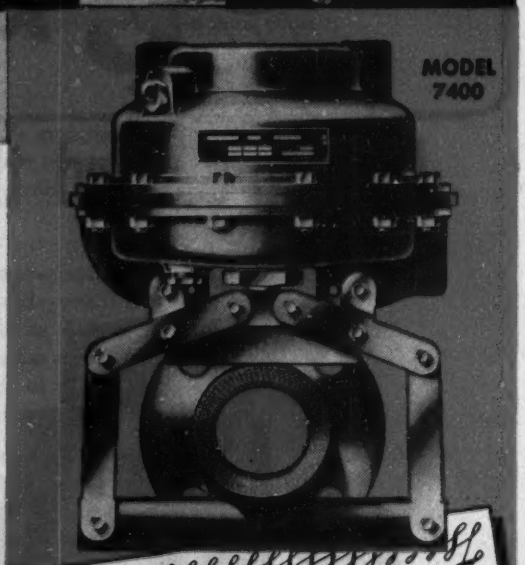
City ..... Zone ..... State .....

☐ I'd like more information. ☐ I'd like to talk with an engineer.

CUSTOMER'S QUOTE

"ONLY FLEX VALVE COULD DO THIS JOB!"





This diaphragm motor-operated Farris Flex Valve is handling a hard-to-convey, semi-solid slurry in a leading chemical processing plant. Before it was installed, other types of valves clogged after as little as a few hours' service. *Yet Flex Valve has performed perfectly for more than 3 years, in a 24-hour, 7-day-week operation.* Many other Flex Valve installations have been giving trouble-free, continuous service for 15 years or more. If you have a problem in controlling flow of any hard-to-handle fluid, send for Catalog No. FL 382-A.

Exclusive FLEX VALVE Features (Pat'd & Pat. Pending)

- Will outwear any metal valve on abrasive service. Proven minimum 11 to 1 life over metal.
- Full pipe capacity.
- Will not freeze up in outdoor service.
- Excellent control characteristics in first ⅓ of travel.
- Complete closure for bubble-air tightness.
- Tight on grits up to ⅛".
- No obstructions, pockets, or internal parts.
- Valve body available in pure gum rubber, neoprene, butyl, buna-n, buna-s, food stock and special compounds.

We Guarantee
YOUR MONEY BACK
if Flex Valve plugs

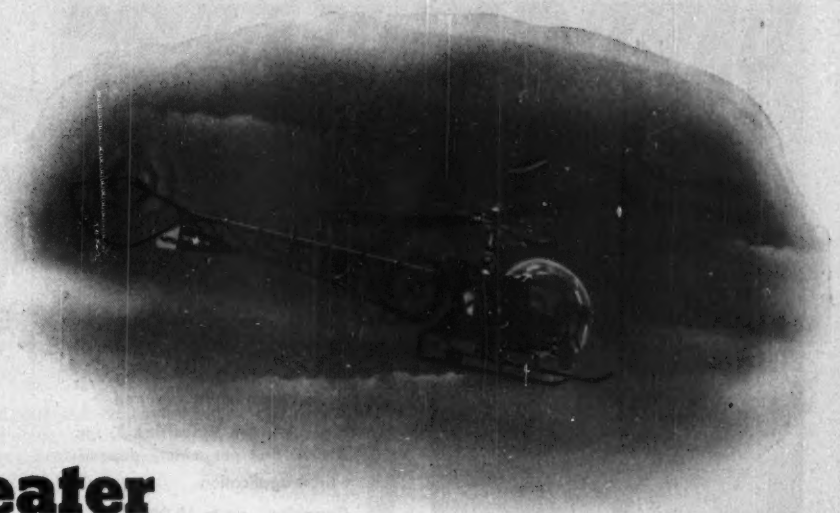
Farris

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Affiliates: Farris Engineering Corp. • Farris Stacon Corp. • Farris Hydrocoal Corp. • Farris Hydrotorque Corp.

how to hatch an eggbeater



FIRST, build a cocoon—a *good* one. So Bell Aircraft Corporation called on Wigton-Abbott Corporation (in conjunction with Tellepsen Construction Co., Inc.) to design and erect a modern $3,000,000 helicopter engineering and manufacturing plant at Fort Worth, Texas.

The results are interesting. The cocoon was started in July, 1951 . . . and the first helicopters ("eggbeaters" to our military forces in Korea) came off the line in record time—only eleven months later. Bell was able to produce appreciably more helicopters during 1952 than the company originally expected. A principal factor was the speed and efficiency with which Wigton-Abbott and its associates had performed.

And that brings us to—

What are YOU Hatching?

The odds are strongly against your wanting a cocoon for eggbeaters. Yours may be for a consumer product . . . or industrial equipment. Or you may be part of the fast-growing petrochemical field. Or you may even be pioneering a new field that hasn't yet been labelled! Whatever it is, Wigton-Abbott Corporation can make valuable contributions in process design, engineering and construction.

If you call us in, you'll be doing what companies of all sizes have been doing for 29 years. Our recent projects include work for General Electric Corp., Eaton Manufacturing Co., Allied Chemical & Dye Corp., Hoffmann-La Roche, Inc., Triangle Conduit & Cable Co., Marlin-Rockwell Corp., Phelps-Dodge Copper Products Corp., Continental Can Company —to name a few. There are many others, of course, of whom we are equally proud.

Busy as you are, we honestly think you'll find it profitable to send for "Packaged Plant Construction." It's a little booklet that describes our many services. It tells how we can assume single responsibility for the many components which go into a complete, efficient job. It's not elaborate or long. It's not aggressive. Just informative. May we send you a copy?

Services for the Process Engineering Field

Design and construction from pilot plant data

★

Process design from client's flow sheet

★

Development of new process

★

Economic surveys and analyses

★

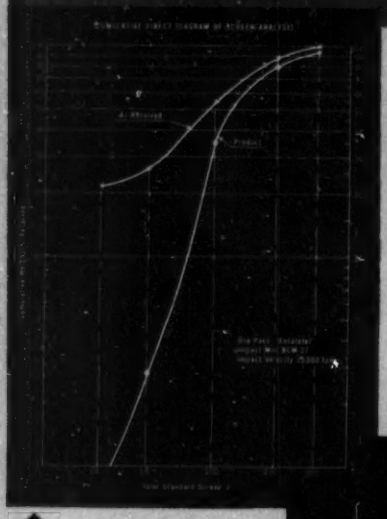
Conversion of existing facilities

Wigton-Abbott Corporation

FOUNDED 1924
Main Offices: Plainfield, N. J.
Process and Plant Designers . . . Engineers . . . Contractors

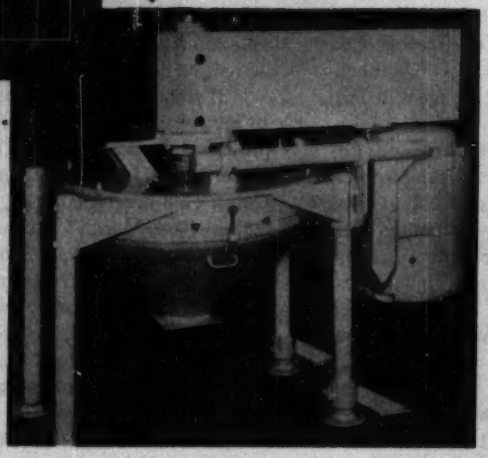


PARTICLE SIZE REDUCTION BY IMPACT!



- **High Productivity Rates** per HP expended
- **Narrow Particle Size Range** . . . reduces quantity of "super fines"
- **Minimum Product Heating** . . . refrigeration rarely required
- **High Impact Velocities** . . . to 25,000 feet per minute dependent on application
- **Capacity** . . . up to 10,000 pounds per hour or higher on friable materials

Typical particle size curves . . . before and after processing material on the "ENTOLETER" Impact Mill



Belt Drive "ENTOLETER" Impact Mill equipped with 25 HP motor

COMPACT . . .

a unit processing over 4 tons per hour occupies less than 14 square feet

SIMPLIFIED MAINTENANCE . . .

the single rotor and impact segments are readily removable for replacement

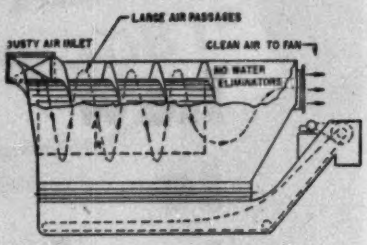
LABORATORY RESEARCH and DEVELOPMENT . . .

Possibilities for new "ENTOLETER" Impact Mill applications are being worked on continually in our laboratory in New Haven. We shall be glad to process samples and return them to you for your evaluation.

The trademark "ENTOLETER" is your guarantee of complete satisfaction.

ENTOLETER DIVISION
The Safety Car Heating and Lighting Company, Inc.
1197 DIXWELL AVE., NEW HAVEN 4, CONN.

Air Tumbler





THE MASTER OF

DUST

IN INDUSTRY

NEW, yet tried in hundreds of diversified applications embracing the **MECHANICAL, CHEMICAL,** and **MINING** industries, the **AIR TUMBLER** exploits to the limit the old and proven principle of dust separation by centrifugal action to which it adds **WATER** as a trapping medium. Its **SIMPLICITY, EFFICIENCY, DEPENDABILITY,** and **ECONOMY** have made the **AIR TUMBLER** standard equipment wherever it has been tried.

For further information write to:

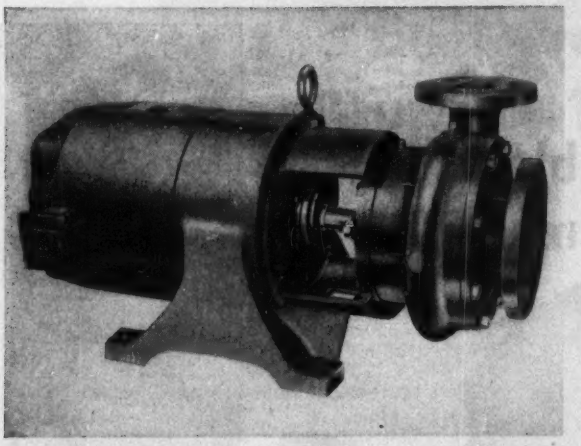
DUST SUPPRESSION & ENGINEERING CO.
P.O. BOX 67, LAKE ORION, MICHIGAN



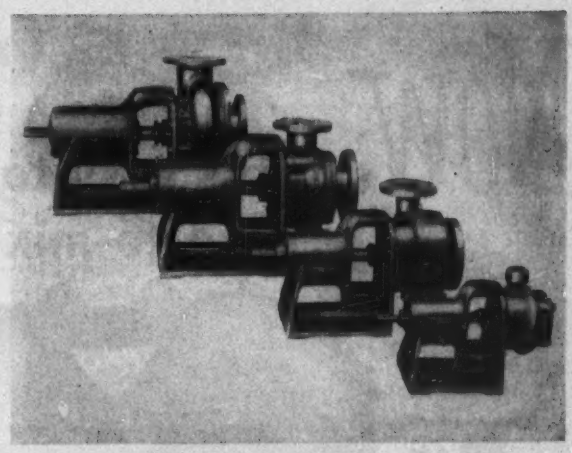
STOPS FALLS!

Revolutionary New Type Safety Grating Eliminates Dangerous Walking Conditions . . . Guarantees Sure Footing.

In a recent test, shown above, a stock strip of Bustin Firm-Grip Grating was submerged in heavy chassis grease and then raised to a 15° slant. Even under those conditions, a man carrying a bulky box walked easily up and down the strip . . . maintaining perfect balance! Send for free Bustin booklet that shows industrial safety applications and specifications. Bustin Firm-Grip Grating Corp., 110 E. 130 St., New York 37, N. Y.

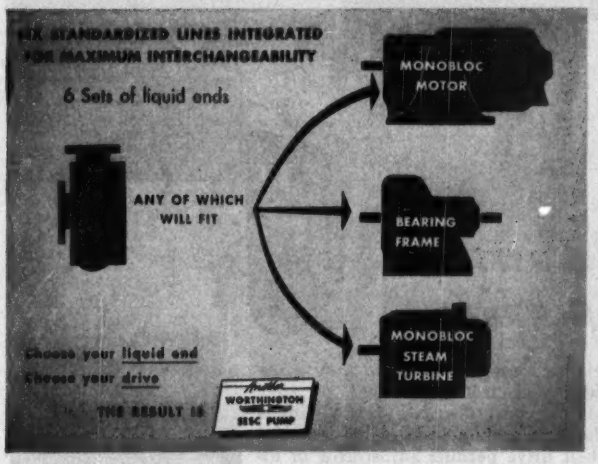


WITH BUILT-IN MOTOR—Well known throughout industry is this compact streamlined Worthington Monobloc centrifugal pump. Worthington SESC standardization makes it possible to interchange any of six sets of liquid ends to the motor housing.



FOR ANY CONVENIENT DRIVE—Frame-mounted units are available in four frame sizes. Like the Monoblocs, they use the same six sets of liquid ends and either conventional packing or a standardized mechanical seal that is readily changed in the field if necessary.

Why Worthington's SESC* pump line means greater availability, broader selection, easier servicing



STANDARDIZATION of *parts, mountings, materials* and *dimensions* virtually eliminates the necessity of slow and expensive custom manufacture to meet special pumping requirements. From 650 parts within its six standardized sets of liquid ends, Worthington can assemble 60,000 *different* standard pumps! C.3.1

Greater availability because the new Worthington pump line will handle more requirements with a *standard*, readily obtainable unit.

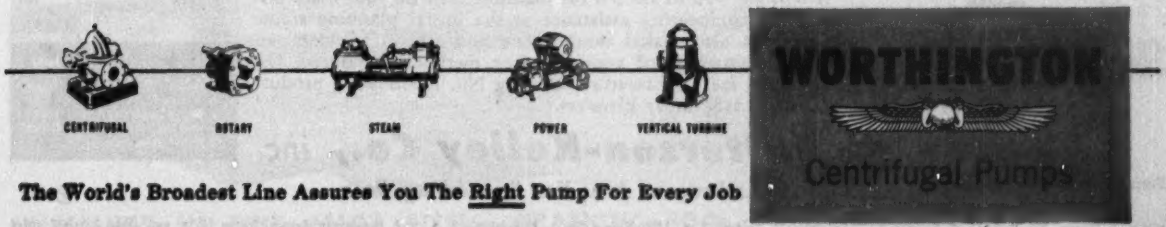
Broader selection because of the complete range of ratings and special design features in the 60,000 different SESC pumps.

Easier servicing because standardized parts mean lower parts-inventory requirements.

This sums up the advantages you can expect when you use Worthington standardized centrifugal pumps. The SESC line is Worthington's latest move towards assuring you the *right* pump for the job.

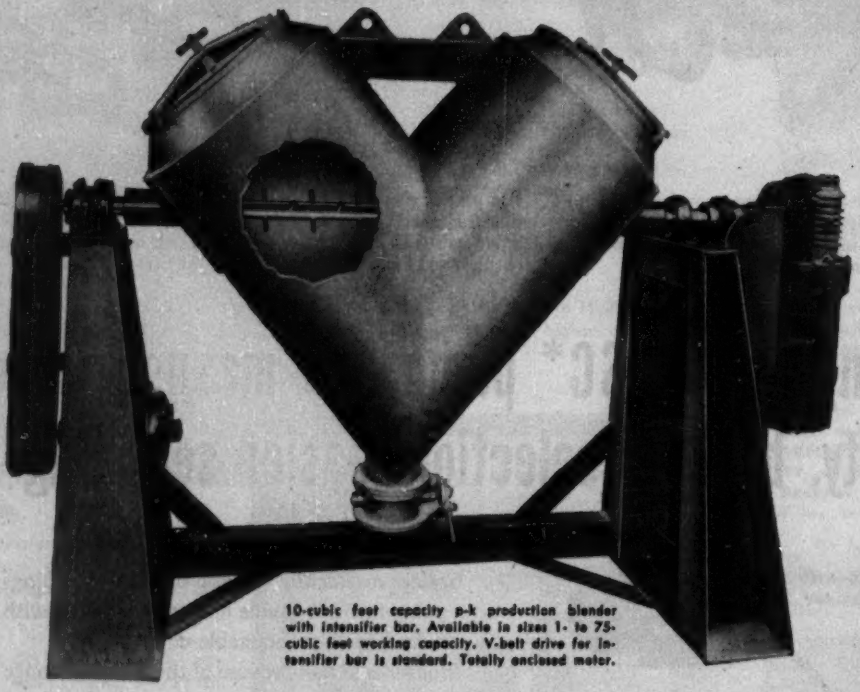
For more information, contact your local Worthington distributor or write for Bulletin W300 B-4 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

*Standardized End Suction Centrifugal



The World's Broadest Line Assures You The Right Pump For Every Job

Now....it's easy to blend hard-to-mix materials



10-cubic foot capacity p-k production blender with intensifier bar. Available in sizes 1- to 75-cubic foot working capacity. V-belt drive for intensifier bar is standard. Totally enclosed motor.

using p-k *twin shell dry blenders with intensifier bar*

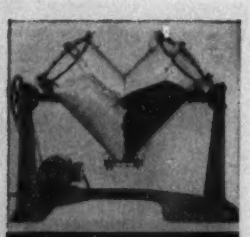


Versatile as p-k twin shell blenders are, they are now made even more so with the addition of an intensifier bar.

More kinds of materials can be processed, such as lumps which occur before and during blending and for dispersion of fluids. Variable speed V-belt drive permits adjustment of intensifier bar action to suit material being processed. Quick opening, dust tight cover makes loading quick and easy.

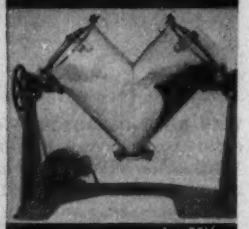
Rotation of p-k twin shell blenders, continuously supplies fresh material to the pins which provide intense local mixing action. The high impact combined with shear, effectively breaks up lumps, disperses materials that tend to agglomerate while tumbling and thoroughly disperses dampening quantities of liquids into solid mixes.

When your process planning includes a blending operation, it will pay you to ask p-k for blending tests on your materials and for engineering assistance at the initial planning stage. Since p-k also makes double-cone and ribbon blenders, an unbiased analysis of your blending methods is assured. Or, write for factual literature—Catalog No. 12, showing production and laboratory blenders.



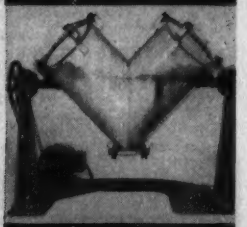
LOAD

As this typical test illustrates; the effectiveness of this new blending principle assures a thorough blend in minutes.



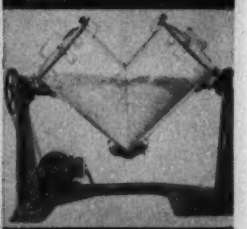
1st REV.

The gentle rolling, folding, dividing and combining action with a simultaneous cross flow can be seen in the first revolution.



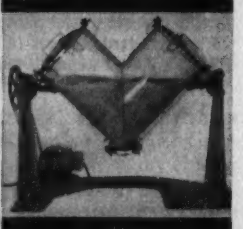
5th REV.

End-to-end dispersion and intimate mixing becomes evident. This is true regardless of particle size, form or density.



1 MIN.

The mass rotates close to the axis and does not require rapid rotation. Neither separation nor attrition takes place.



2 MIN.

A thorough blend has been achieved. Laboratory or pilot plant blender illustrated is available in 4 and 8 quart sizes.

the Patterson-Kelley Co., inc.

150 Lackawanna Ave., East Stroudsburg, Penn.

Patented and patents pending

1104

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities

Know the best way to get the best tube steel for you? Ask the experts!

This month's report is on:

SICROMO 2

Has outstanding surface and structural stability at 1200°F. Has better oxidation and corrosion resistance than 2% Cr.-Mo. steel. Recommended for service up to 1200°F. as tubes in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping. Also as return-bend forgings for oil heaters.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

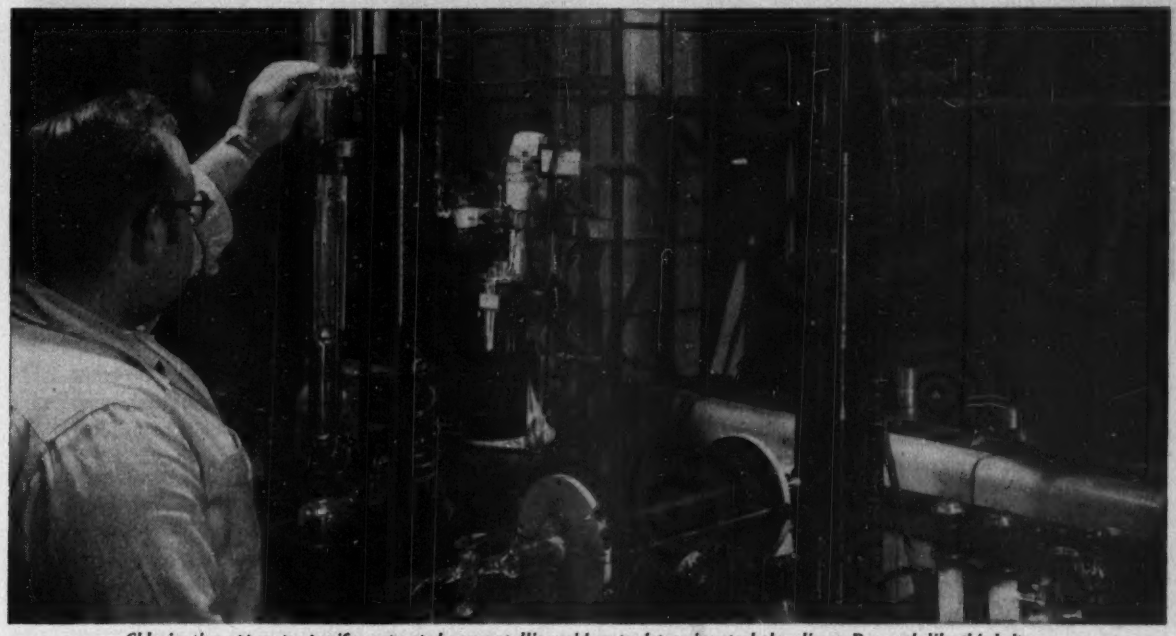
Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

* *Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

SEVERAL high temperature tube steels may solve your heat, pressure, corrosion and oxidation problems. But only one steel will give you maximum tube life per dollar —the best life/cost ratio.

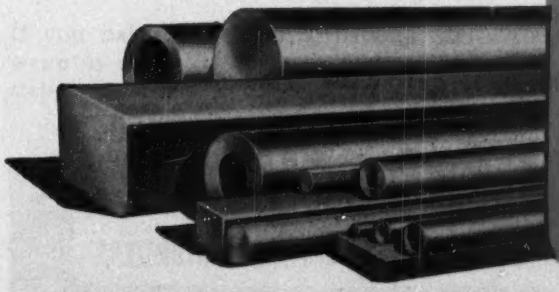
The best way to get this steel is to ask the experts—the metallurgists of The Timken Roller Bearing Company. Backed by more than 20 years of steel research and experience, they're recognized authorities on high temperature steels. With 24 different analyses to choose from, they'll help you select the best tube steel for your particular application. And uniform tube quality is assured by the Timken Company's rigid quality control from melt shop through final tube inspection.

Let our "RSQ"—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



Chlorination apparatus purifies extracted non-metallic residues to determine steel cleanliness. Research like this helps assure the Timken Company's leadership in high temperature steels.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



TIMKEN
Fine Alloy
STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

New MIKRO AIR CONVEYING SYSTEM

Ventilates and Cools as it Carries Material to the MIKRO-COLLECTOR*

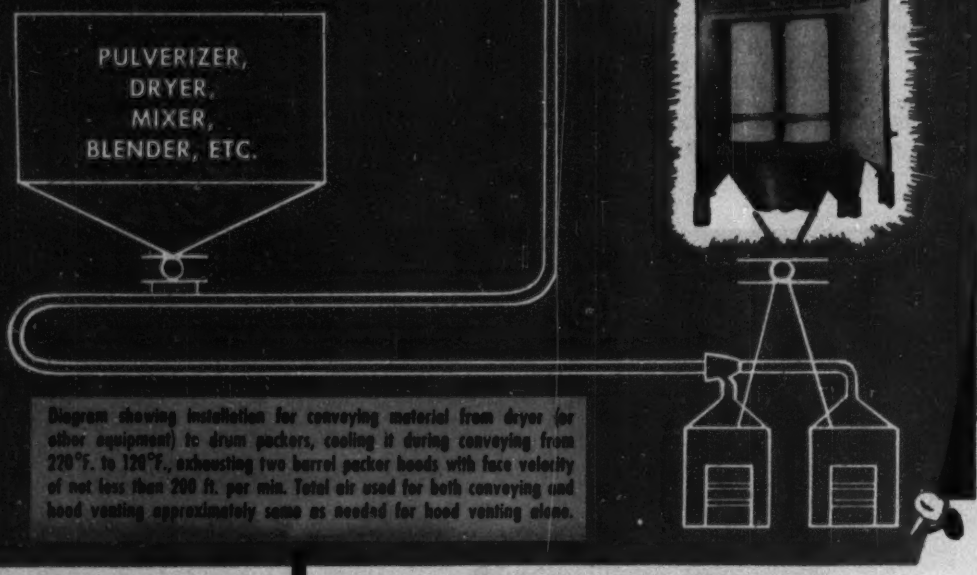


Diagram showing installation for conveying material from dryer (or other equipment) to drum packers, cooling it during conveying from 220°F. to 120°F., exhausting two barrel packer hoods with face velocity of not less than 200 ft. per min. Total air used for both conveying and hood venting approximately same as needed for hood venting alone.

- *Permits use of ventilated air from packaging hoods to be used for conveying material*
- *Reduces required size of dust collecting unit as much as 50%*
- *Conveys material from any dust source (dryer, pulverizer, blender, tank, vat, etc.)*
- *Cools the conveyed material without mechanical refrigeration*
- *Spans distances up to 200 feet*
- *Will by-pass any obstacle in the form of existing machinery or equipment*

These and other advantages make the MIKRO Air Conveying System an ideal low-pressure, low-cost method of conveying material from any dust source. Its complete flexibility helps solve plant layout problems without costly flow sheet revisions.

This dust-tight installation conveys up to 800 grains of dust per cubic foot of air . . . Makes possible the return of filtered air to processing area, thus reducing loss of heated or conditioned air . . . Assures freedom from infestation and metallic contamination . . . Easily cleaned . . . Eliminates booster fan, thus preventing change in particle sizing.

The MIKRO Air Conveying System is more economical to install, operate and maintain than a conventional mechanical system. Even greater saving is effected when stainless steel or nonferrous construction is required.

*Patents applied for by H. J. Hersey, Jr. and Pulverizing Machinery Company

SEND FOR new MIKRO AIR CONVEYOR Bulletin

PULVERIZING MACHINERY COMPANY
55 Chatham Road **Summit, New Jersey**

PRESERVE OUR HERITAGE: FAITH, FREEDOM AND INCENTIVE

MIKRO-COLLECTOR 100 PER CENT
Reg. U.S. Pat. Off.
By the makers of
MIKRO-PULVERIZERS and MIKRO-ATOMIZERS

YOUR PROCESSING EQUIPMENT PROBLEM

The shortest distance between these 2 points

THE RIGHT SOLUTION

is a conference with

PROCTOR ENGINEERS



When you sit down with Proctor engineers to discuss a processing equipment problem you are taking the shortest path to the surest solution. You are availing yourself the benefit of a breadth and depth of experience that is virtually unequaled in any other single equipment manufacturer.

The result—carefully designed, well built equipment that will meet precisely the need for which it is created.

Proctor project engineered equipment is operating today in all branches of the process industries—heavy chemicals, pharmaceuticals, food, leather tanning, synthetic textiles, rubber manufacturing, plastics and many more.

With their wide range of experience in building individually designed drying and fiber processing machinery—Proctor engineers are well equipped to apply their skill to developing, engineering and manufacturing other processing machinery. This machinery may be related to drying equipment and used in the same range—or it may be totally unrelated but require the same basic kind of engineering and manufacturing skill.

If you have a problem involving processing equipment—write us today in as much detail as possible. It is the first step toward the right solution.

PROCTOR
CREATIVE ENGINEERING
AT WORK

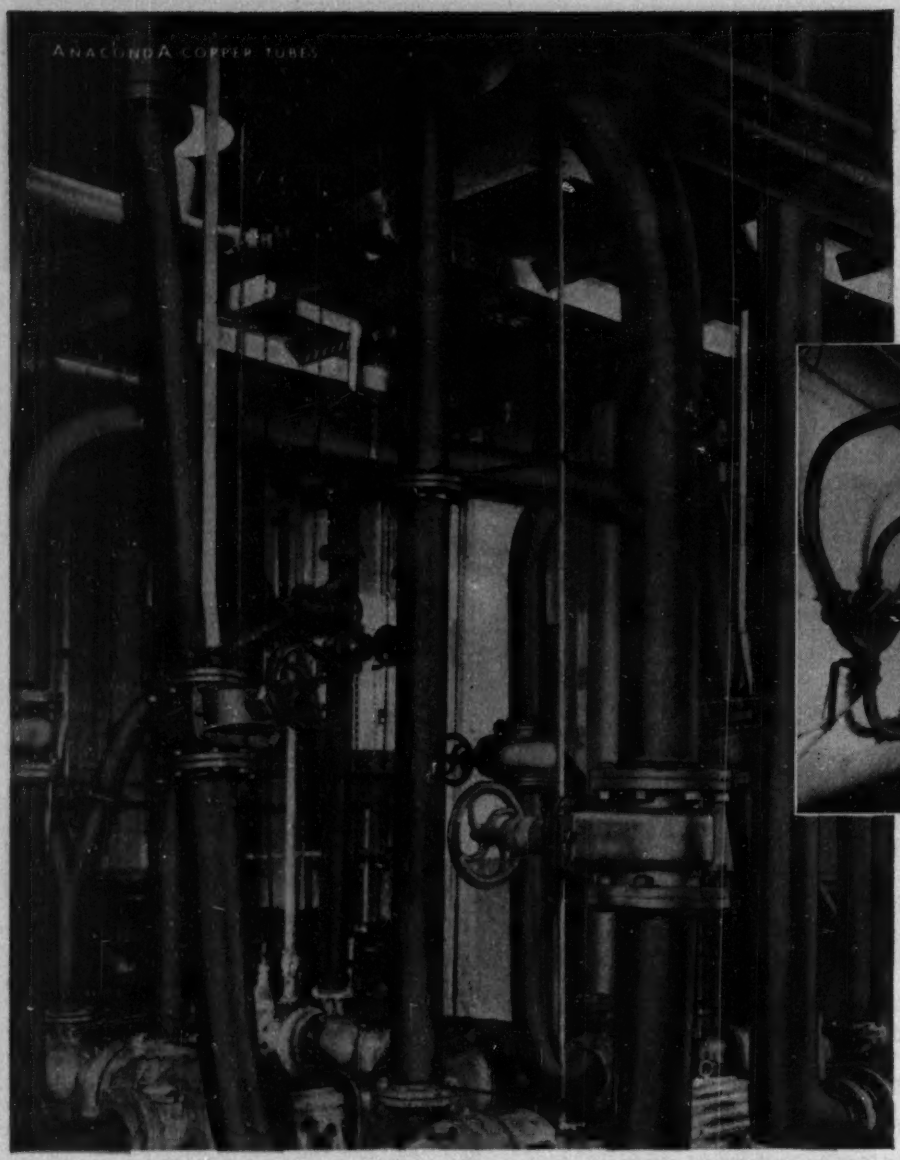
Wide Range of Proctor Equipment Available for Processing Synthetic Fibers and Yarns

Over the years Proctor engineers have worked closely with the technicians of the textile and chemical companies in the development of equipment for the processing of synthetic fibers. Their association with the production of man-made fibers goes back to the very earliest days of the industry—and has kept step with it as it has developed at such an accelerated pace during recent years. Proctor equipment used in processing synthetic fibers and yarns includes:

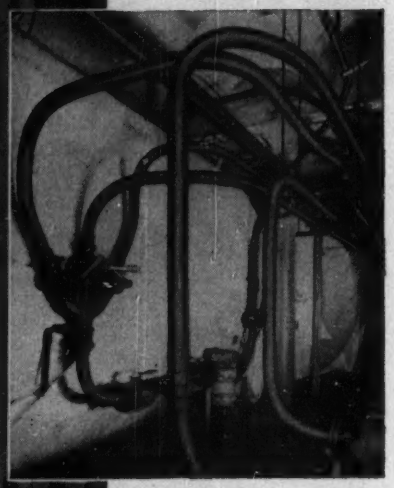
1. Rayon textile filament yarn bobbin and cake dryers for straight drying or drying in high humidity cycles for the ultimate in uniformly shrunk dried yarn.
2. Tow dryers of conveyor and drum or contact type for synthetic yarns in tow form.
3. Polymer dryers of the conveyor type.
4. Cut staple dryers of conveyor type for various drying processes for all types of synthetic fibers.
5. Batch and continuous conveyor type dryers for waste.
6. Electronic dryers (induction type) for rayon cakes drying, twist setting, tire cord, etc.
7. Cotton linter conveyor type dryers for bleached linters and for redrying linters.
8. Batch and automatic conveyor type dryers for synthetic yarns in skein form.
9. Steam ovens for setting twist in synthetic yarns after twisting.
10. Special type drying equipment for synthetic yarns or affiliated products in any specially processed form.

Proctor engineers are prepared to supply any type of precision processing machinery for synthetic fibers. Long association with the field has given them a thorough understanding of processing problems that will result in equipment precisely suited to your needs.

PROCTOR & SCHWARTZ, INC.
711 Tabor Road • Philadelphia 20, Pa.
CREATIVE ENGINEERS AND MANUFACTURERS OF PRECISION PROCESSING EQUIPMENT



PUMPING ROOM of Liebmann Breweries, Inc., Brooklyn, N. Y. Notice short bends at pumps and braze into main line (at top of picture). These are the kinds of savings you get with ANACONDA Copper Tubes.



FINISHED BEER is fed through 2-in. ANACONDA Copper Tubes to bottling room.

VERSATILE COPPER:

Efficient, economical piping for brewers of Rheingold Beer

In the pictures above you'll find numerous reasons why ANACONDA *Copper Tube* pipelines are *economy* pipelines. They adapt easily to any plant layout and equipment. Long lengths of lightweight ANACONDA Copper Tubes speed assembly, too. They may be bent so you can clear beams, girders and other obstructions—without extra joints and fittings. And fewer fittings mean less flow resistance, lower pumping costs. ANACONDA Copper Tubes with solder-type fittings also permit you to make sound, economical connections. You can also dismantle and reassemble *copper* tube lines easily to meet changing plant conditions.

ANACONDA Copper Tubes are strong, rustproof and corrosion-resistant. They remain smooth and clean inside.

For reliable service on ANACONDA Copper and Copper Alloys—consult your Anaconda Distributor.

Write for free booklet, "ANACONDA Copper Tubes for Industrial Applications" to *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.* 3332

ANACONDA®

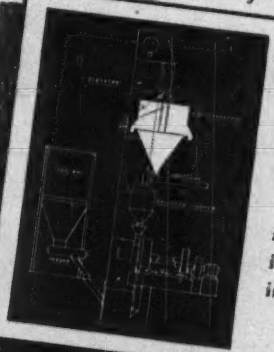
Makers of copper tubes for industrial processing, water, heating, soil, waste and vent lines; welding rods; flexible metal hose and tubing; heat exchanger tubes; bus conductors; sheet copper; refrigeration products.



Here's How STURTEVANT Air Separators Increase Production of Fines... Lower Separation Costs

- Sturtevant Air Separators effect production savings by increasing output by 25 to 300%... reducing power consumption by as much as 50%.
- They efficiently carry off all classified materials in any desired fineness from 40 to 325 mesh and finer... eliminate the need of screening in certain applications.
- Capacities available from ¼ to 50 tons per hr.

Write for full details, today.



Sturtevant Air Separator in "closed circuit" with pulverizer. This combination increases tonnage and reduces costs in all types of industry.

Sturtevant Mill Company

100 Clayton Street, Boston 22, Mass.

Designers and Manufacturers of: CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS • MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

40 YEARS OF

Dependable Service

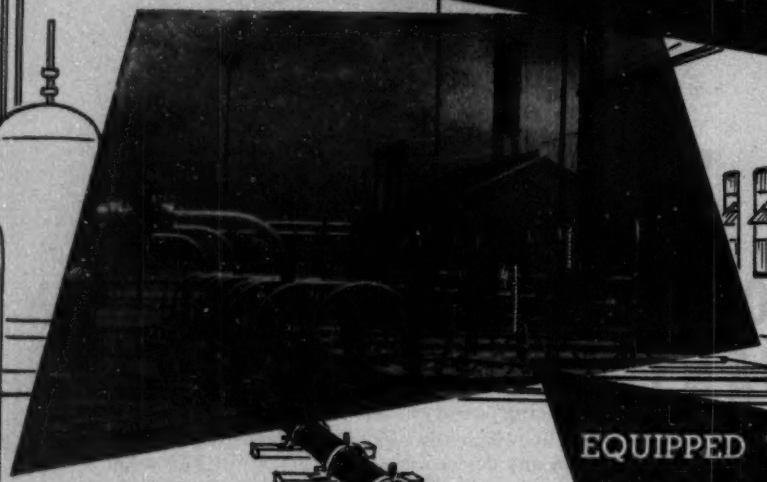
ON PIPE BENDS AND
PREFABRICATED PIPING

TEXAS PIPE BENDING COMPANY

PIPE BENDS
PIPE COILS
WELDED HEADERS

HOUSTON TEXAS

OFFICE AND PLANT
310 FRIO STREET
WEntworth 6605



EQUIPPED TO
FABRICATE BENDS
AS LARGE AS . . 30" O.D.



SALES OFFICES:
7 EAST 42 ST.
NEW YORK CITY
★
444 NORTH LA SALLE ST.
CHICAGO
★
317 CITIZENS BLDG.
CLEVELAND, O.

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

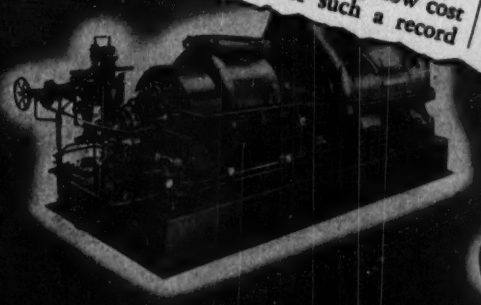
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.



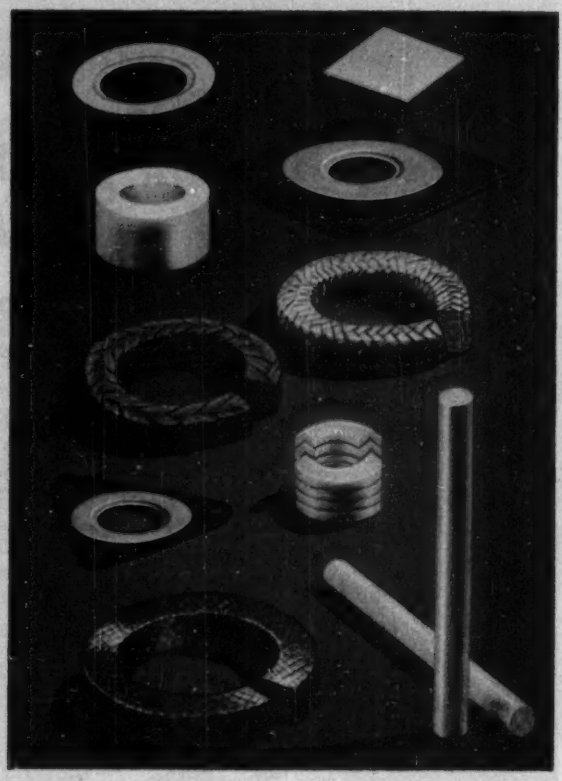


For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE HARTFORD 1, CONN

Seven reasons why so many chemical packing problems are being solved by R/M Teflon*



1. **Teflon is not affected by chemicals within the temperature range of -80°F. to 500°F.**
2. **Teflon has high heat stability.**
3. **Teflon has excellent nonadhesive properties.**
4. **Teflon is nonflammable.**
5. **Teflon possesses excellent electrical properties.**
6. **Teflon's water absorption is zero.**
7. **Weather does not affect Teflon.**

These seven unique properties make Teflon an ideal packing and gasket material for the chemical industry. Raybestos-Manhattan's Teflon Packings and Gaskets are available in a variety of combinations for glass, glass-lined and stainless steel piping, and for pumps, valves and practically all kinds of fluid-handling equipment. Included in the line are solid rings; Vee-Flex® rings; braided and plastic packings for stuffing boxes and valve stems; "envelope" gaskets; solid gaskets in round, square and irregular shapes; gaskets for handholes, manholes and flanges; gaskets for distillation columns; gaskets for covers on tanks, kettles and autoclaves; gaskets for flanges and nozzles on glass and glass-lined pipe. Into each goes a know-how of 50 years' packing experience.

**Du Pont's trade-mark for its tetrafluoroethylene resin*

DO YOU FABRICATE YOUR OWN PARTS?
If so, order R/M Teflon in sheets, rods or tubes to your specifications.

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Neenah, Wis.; Peterborough, Ontario.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Teflon Products • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

Where dirt, dust and corrosion are a problem...



TYPE E turbines can handle it!

Spencer Chemical Company of Pittsburg, Kansas, has a total of ten 47-hp Type E turbines for driving blowers. Units are mounted outdoors on structural steel and are exposed not only to the elements, but to a corrosive ammonium-nitrate atmosphere.

Continued satisfactory operation of the turbines under these conditions is proof that the Type E can "take it" . . . proof that Type E construction keeps foreign matter out . . . proof that materials used resist corrosion and erosion.

Weather and corrosion resistance are important . . . in the chemical industry and in other industries as well. Important, too, are other Type E features, such as dual protection against overspeed, floating movement of governing and trip linkages, centerline support, parts interchangeability between wheel sizes. Outstanding Type E design assures safe, trouble-free, economical performance for long periods of continuous operation . . . or instant operation when used as a stand-by drive.

Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multistage units.

Get the facts from your nearby Westinghouse office, or write for twenty-page book B-3896. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30542

YOU CAN BE SURE...IF IT'S
Westinghouse
TYPE E Turbines

Wagner

Protected Type Motors

solve tough production problems

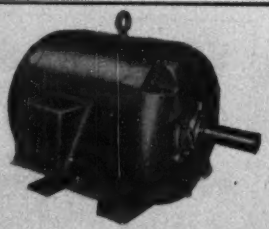
Do you need motors to operate under severe conditions? If you do—you can solve your problem easily with Wagner's complete line of protected type motors.

They are specifically designed for use wherever EXTRA protection is demanded —for bearings or windings... against corrosive vapors or abrasive dusts... in explosive atmospheres or in exposed outdoor locations.

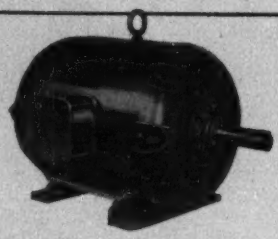
In their specific applications, each of these Wagner Motors assures complete protection of vital parts. Wagner Motors are backed by more than sixty years of motor building experience.

* * *

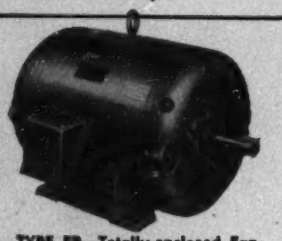
A Wagner engineer will be glad to help you select the correct motor for *your* specific application. Consult the nearest of our 32 branch offices, or write for Bulletin MU-185 for complete information.



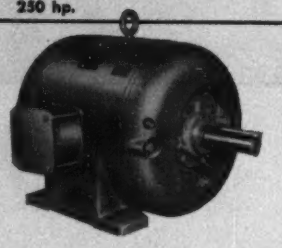
TYPE CP—Totally-enclosed Fan-cooled. Steel frame. 1 to 250 hp.



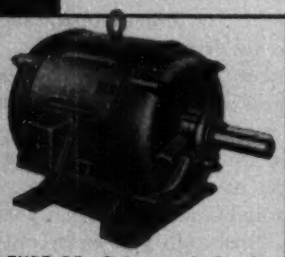
TYPE HP—Explosion-proof. Steel frame. 1 to 250 hp.



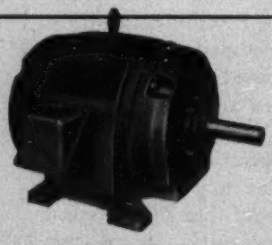
TYPE EP—Totally-enclosed Fan-cooled. Cast iron frame. 2 to 250 hp.



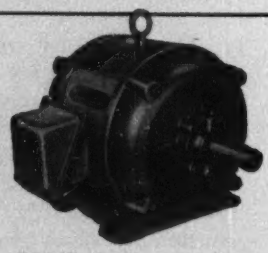
TYPE JP—Explosion-proof. Cast iron frame. 2 to 250 hp.



TYPE RP—Drip-proof. Steel frame. ½ to 400 hp.



TYPE XP—Splash-proof. Cast iron frame. ¾ to 200 hp.



TYPE TP—Totally-enclosed, non-ventilated. ¼ to 15 hp.



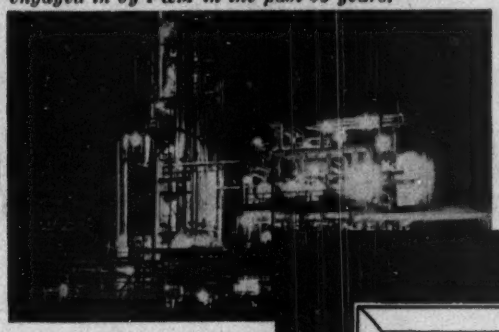
WAGNER ELECTRIC CORPORATION
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS • AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

M33-10

JEFFERSON CHEMICAL CO., PORT NECHES, TEXAS — Ethelyne Unit. *Another one of the more than 11,000 successfully completed electrical contracting jobs engaged in by F&M in the past 35 years.*



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When electrical installation problems call for the superior resources and "know-how" of a field leader, this Fischbach and Moore sign is the one that generally appears on the job in question. It's "Tradition's Trademark" when you want the best.

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FROM COAST TO COAST *An organization that has to its credit every conceivable type of electrical installation.*

COMPLETE ORGANIZATIONS AT: *New York, Atlanta, Dallas, Houston, Los Angeles, San Francisco, Detroit, Chicago, Pittsburgh.*

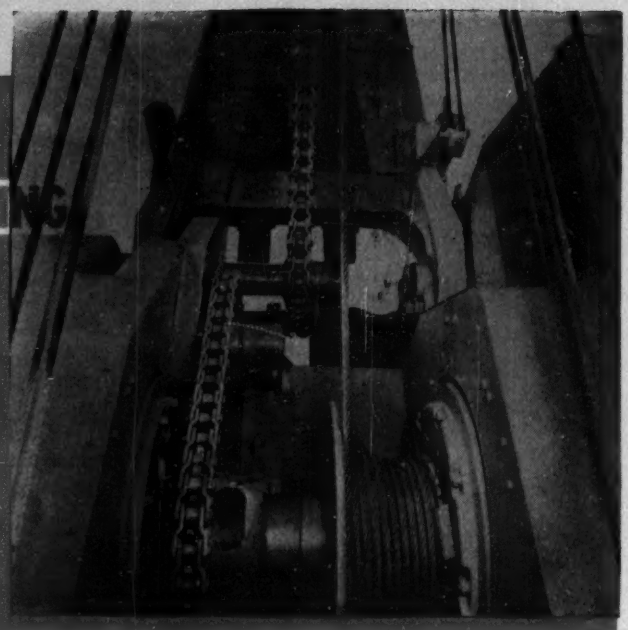
just a few Jeffrey products . . .

FOR IMPROVING HANDLING AND PROCESSING

Space does not permit a complete showing of all the products in the broad Jeffrey line. A few are displayed here to give you an idea — our NEW Catalog No. 418 goes into more detail. It will prove a handy reference if you are interested in improving handling, processing and reducing operations in your plant. Send for your copy TODAY.

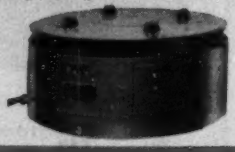


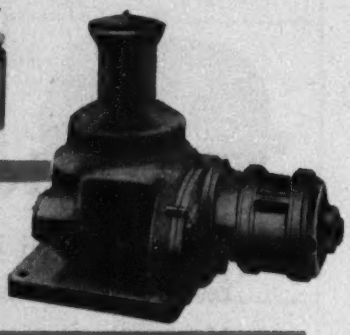
BUCKET ELEVATORS—standardized to save you time and money. A type and size, buckets mounted on belt or chain, to give your material a lift . . . to keep production moving in a way that spells more profit for you.



Above: A complete line of Chains and Transmission Machinery . . . bearings, idlers, traction wheels, take-ups, sprockets, gears, hub boxes, couplings, etc.

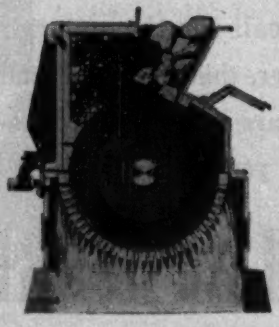
Below: Jeffrey-Traylor Barrel Packer. Cuts shipping costs—reduces size of container as well as increases its capacity. Also electric vibrating Packing Tables, Feeders, Conveyors, Dryers and Coolers.



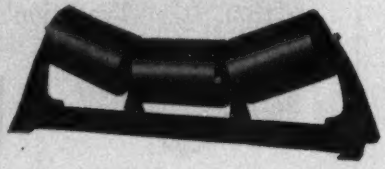


CAR PULLERS—two sizes for moving from one to six cars. Save time and expense. No locomotive needed.

PULVERIZERS AND CRUSHERS—Rigid or swing hammer, single or double roll, FLEXTOOTH or Rotary Ring types to provide uniform reduction with a minimum of fines. Reduce coal, limestone, gypsum, pulp lap, garbage, metal turnings, alum, chips, sewage screenings, sugar cane, to desired fineness the Jeffrey way.



BELT IDLERS—furnished in both troughing and flat belt types for belt widths from 14" to 60". Idlers are of the anti-friction type, insuring low power cost and smooth performance.



THE JEFFREY MANUFACTURING CO.

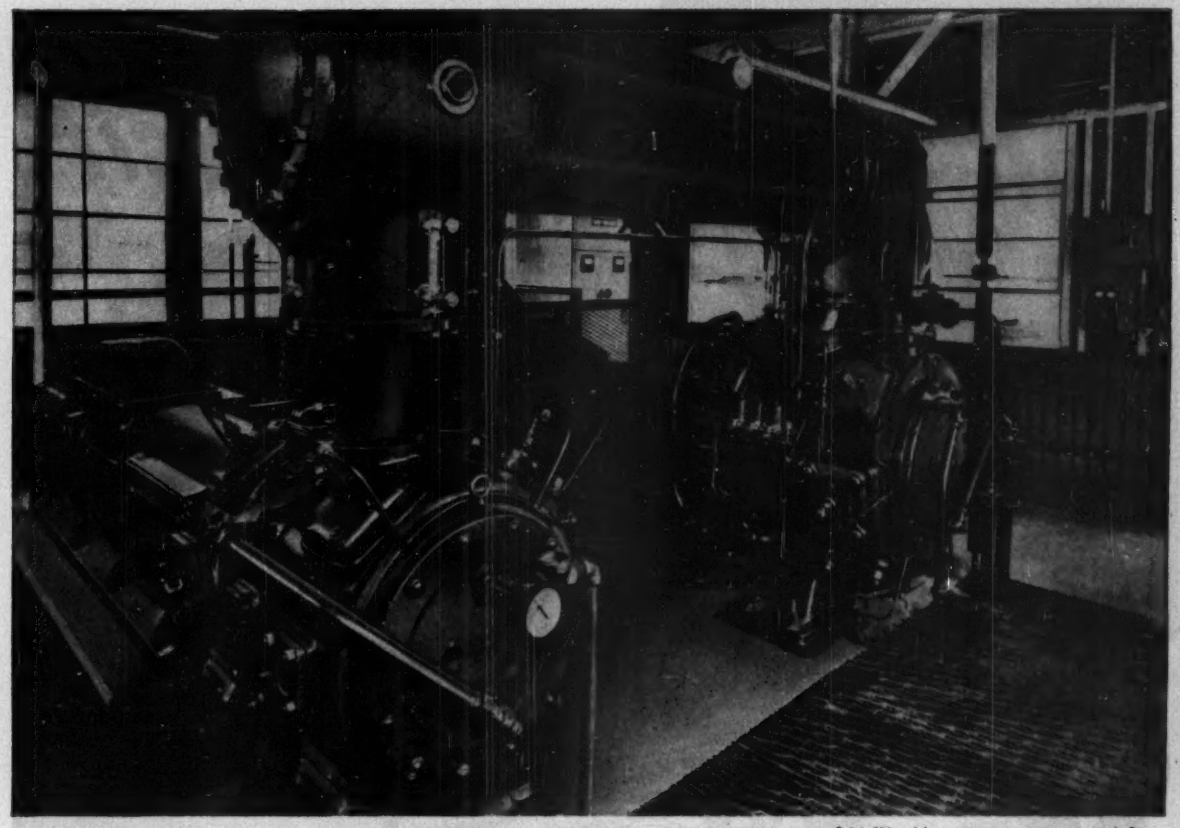
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Columbus 16, Ohio

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PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED . . . IT'S A JOB FOR JEFFREY!



WORTHINGTON DC-2 HORIZONTAL AIR COMPRESSOR, one of 14 Worthington compressors used for various services at the Girard Point, Pa., station of the Gulf Oil Company.

THIS COMPRESSOR KEEPS PACE WITH VARIABLE LOADS

Like compressors in industry everywhere, this installation at a large eastern refinery must face many variable load problems. Unless properly handled, variable compressor loads often result in wasted power and high running costs.

Worthington Five-Step Variable Capacity Control solves this problem.

The by-pass regulation—as achieved by suction valve unloaders and clearance pocket unloaders—is exclusively Worthington and offers these important advantages:

Economy of power—the air required at any moment determines the power used.

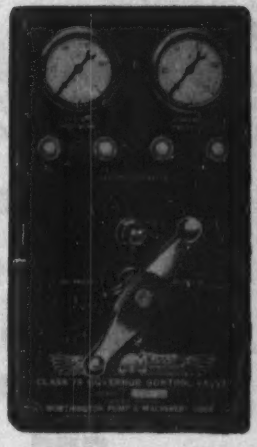
Simplicity—inlet valves and unloading mechanism form one individual element, easily accessible.

Low operating temperatures—a cooler cylinder insures improved lubrication and low oil consumption.

This Type DC-2 compressor is also equipped with the exclusive Worthington Feather* Valve—the lightest and most efficient compressor valve available.

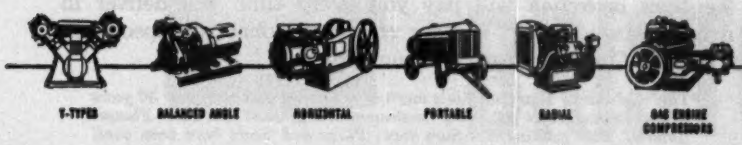
Write for air compressor bulletin L-675-B1B to your nearest Worthington district office or to Worthington Corporation, Compressor Division, Buffalo, New York.

*Reg. U. S. Pat. Off.



A GLANCE AT THE INDICATOR PANEL of the Worthington five-step governor shows operating capacity at any moment.

K.2.13



WORTHINGTON
Compressors

No Other Compressor Will Outperform a Worthington

Caltex drums get protection in transit



Tri-Sure

Reg. U.S. Pat. Off.

CLOSURES

prevent

LEAKAGE

CONTAMINATION

and

PILFERAGE

CALTEX *protects* its investment in materials and processing —by using Tri-Sure* Closures on drums for Caltex Petroleum Products.

The Tri-Sure *Flange*, *Plug* and *Seal* give *dependable* protection —and that kind of protection is essential for the drums that carry the name Caltex throughout the free countries of the Eastern Hemisphere. The Tri-Sure Flange is integrally assembled with the drumstock; the Tri-Sure Plug fits securely into the Flange; and the Tri-Sure Seal forms a leak-proof covering which cannot be removed unless it is deliberately destroyed.

This exclusive Tri-Sure assembly prevents leakage, tampering and losses. It gives incontestible *proof* to every customer that you are *delivering* the same quality and quantity you put into your drums.

Tri-Sure protection will *pay* you every time you deliver in drums. Make it part of your company policy, by specifying *Tri-Sure Closures* on every drum order.

**The "Tri-Sure" Trademark is a mark of reliability backed by over 30 years serving industry. It tells your customers that genuine Tri-Sure Flanges (inserted with genuine Tri-Sure dies), Plugs and Seals have been used.*

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Tri-Sure Products Limited, St. Catharines, Ontario, Canada

Here's the only tool you need to exactly calibrate the control system of this instrument!





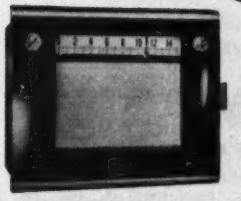
Only one simple adjustment with a standard 1/4 in. wrench exactly calibrates the control system in a Bristol Series 500 Air-Operated Control System.

That's because the control units and parts are so accurately designed and the manufacturing tolerances so closely controlled that the control system can be completely disassembled and after being reassembled, even with replacement parts, can be *exactly calibrated by only one simple adjustment.*

No wonder a Bristol Series 500 Controller is the simplest and easiest control system on the market to service.

Write for Bulletin A120 for full details. THE BRISTOL COMPANY, 109 Bristol Road, Waterbury 20, Conn.

Strip and round chart Electronic Dynamaster Air-Operated Controllers are also available.

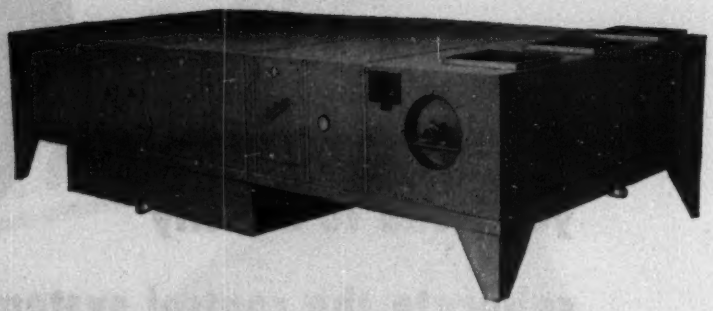


BRISTOL *The dependable Guidepost of Industry*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

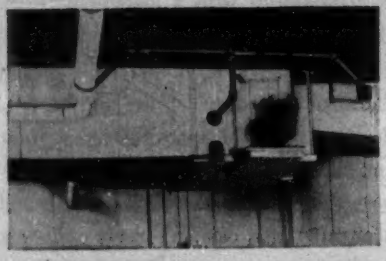
easy to install

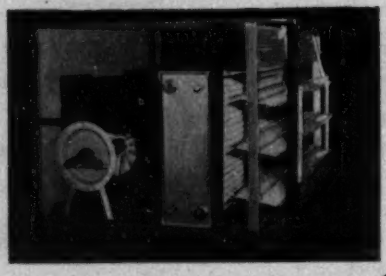
easy to live with



"Buffalo" "PC" CONDITIONING CABINETS







When you air condition, you want three things—as inexpensive a job as will do, equipment that installs economically—and most important—equipment that gives satisfaction over a long period.

Cost-wise, the central cabinet is the least expensive part of your system; considering compressor, duct-work and building modifications.

Satisfaction-wise, it's the most important!

If the fans are over rated, or inefficient, you'll suffer. If the coils are inefficient or untrustworthy, you'll have poor air conditioning.

Why not be sure that on this lowest-cost part of your system, you get the best?

"Buffalo" "PC" Air Conditioning Cabinets, to heat, cool, humidify or dehumidify, or any combination of these functions, have been in use for more than twenty years. They are sectionalized, to pass thru standard building openings, and assemble easily on location. They have husky, quiet, mixed flow fans mounted on large, vibrationless hollow shafts. They have Aerofin coils, by far the best obtainable. They have sturdy, outside-the-housing bearings, for convenient lubrication even after cabinet insulation. In short, they are built according to the "Q" Factor* which makes them your best buy!

"Buffalo" Engineering Sales Representatives in principal cities are anxious to serve you. Let them give you full details—no obligation.

*—*The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

501 MORTIMER ST. BUFFALO, NEW YORK

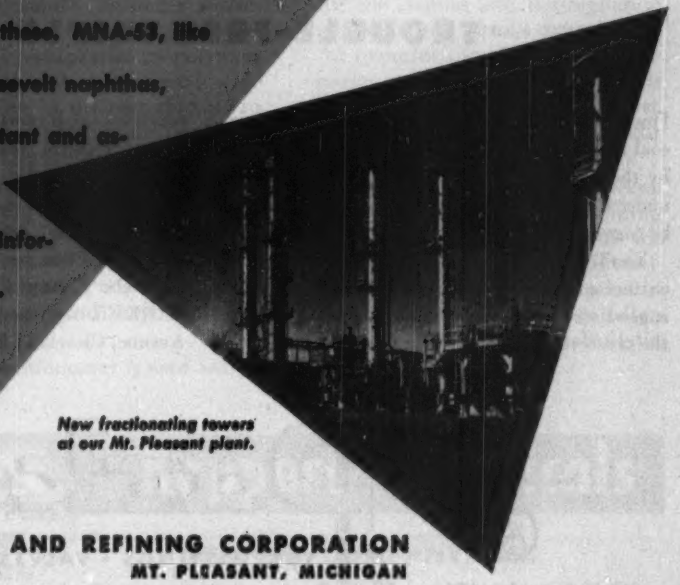
PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

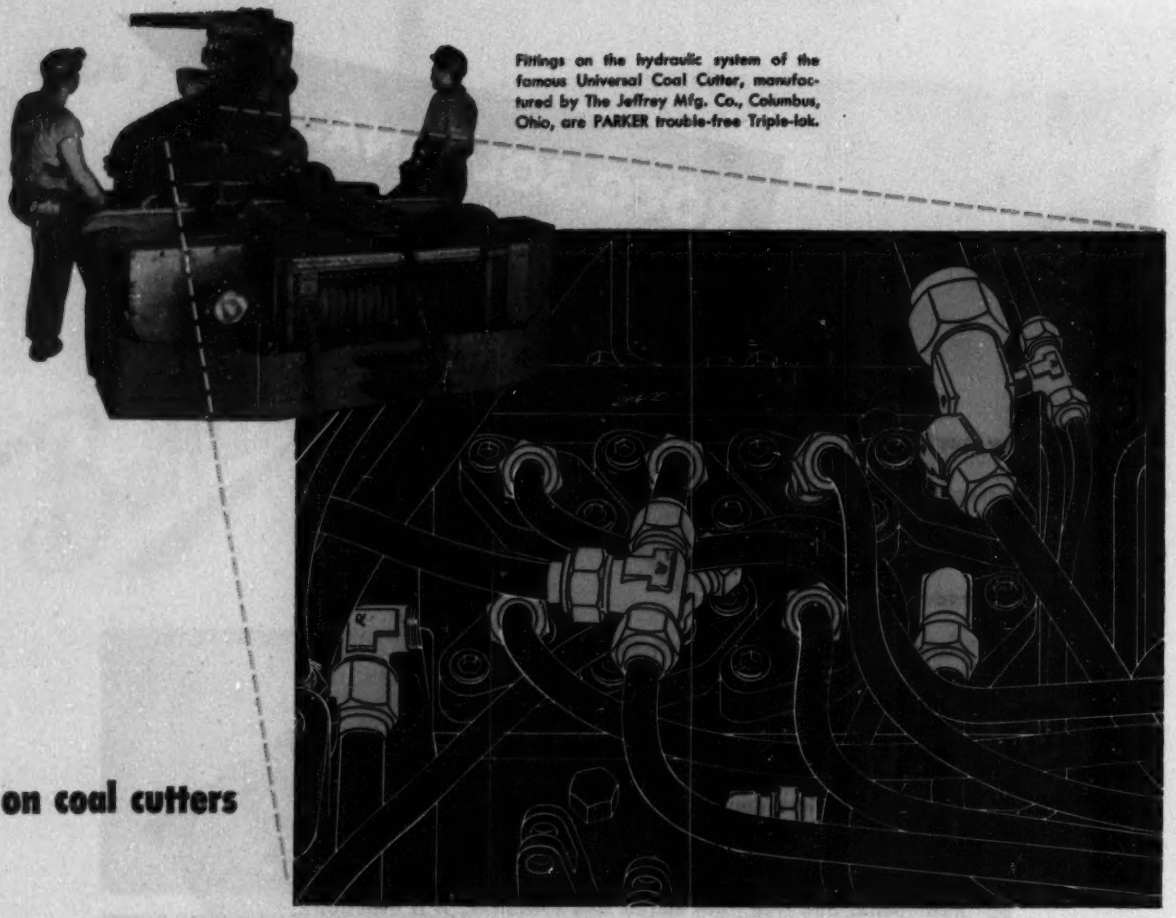
ROCO-SOL MNA-53
ROOSEVELT'S NEW FAST-DRYING NAPHTHA

▶ New fractionating and treating facilities at Roosevelt have made possible the production of an entirely new merchantable naphtha — MNA-53. Similar to textile spirits, MNA-53 is, however, much faster drying, thus resulting in substantial savings in both operation time and money. MNA-53 has a low sulphur and aromatic content, a high paraffin content, and it is low in naphthenes and free from olefins and di-olefins. It is especially suitable for use in the manufacture of such products as lacquers, rubber adhesives, under coatings, protective coatings and sound deadeners, though its use is by no means limited to these. MNA-53, like other high quality Roosevelt naphthas, is available in a constant and assured supply. Write today for complete information and specifications.



New fractionating towers at our Mt. Pleasant plant.

ROOSEVELT OIL AND REFINING CORPORATION
MT. PLEASANT, MICHIGAN



Fittings on the hydraulic system of the famous Universal Coal Cutter, manufactured by The Jeffrey Mfg. Co., Columbus, Ohio, are PARKER trouble-free Triple-lok.

on coal cutters

Tube it up...Forget it...WITH PARKER

TROUBLE-FREE TRIPLE-LOK FITTINGS

Few machines get rougher use than coal cutters in coal mines. Subjected to severe vibration, caused by the action of the cutting head, and operating under the most adverse conditions, all parts must be ruggedly built, including the hydraulic system.

You'll find Parker Triple-lok Fittings on coal cutters and many other machines used in rough, rugged service because they are leakproof under the severest conditions of vibration, elevated temperatures, high pressures and repeated assembly. Parker Fittings meet the specifications of the A.S.M.E. Code for Pressure Piping, as well as J.I.C. and S.A.E. standards.

So *tube it up* and *forget it* . . . with Parker Triple-lok Fittings. Ask your Parker Distributor for Tube Fitting Catalog 4300, or write The PARKER Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

This does it



Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

Precision Mark of

Leakproof Tube Fittings

Parker

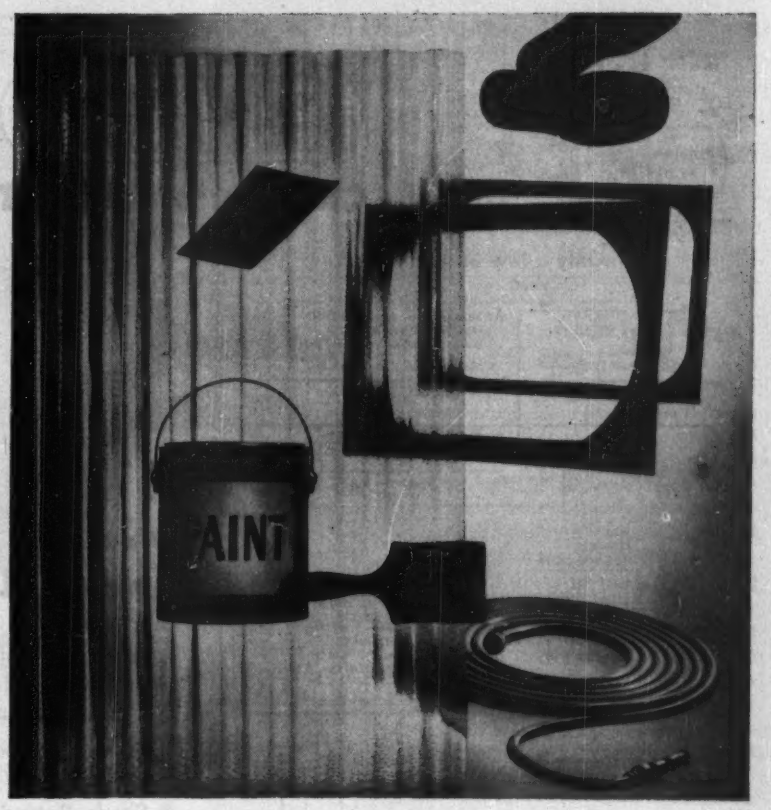
TUBE FITTINGS • VALVES • O-RINGS

Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

Parker

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BOSTON 15, Mass.—A. E. Borden Co., 176 Brookline Ave.
BRYSON CITY, N. C.—Wallace Co. of Carolina, P.O. Box 572
BUFFALO 7, N. Y.—Whitehead Metal Products Co. 2128 Elmwood Ave.
CAMBRIDGE 39, Mass.—Whitehead Metal Products Co. 281 Albany St.
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COLUMBUS 8, O.—Williams & Co., 851 Williams Ave.
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KNOXVILLE 5, Tenn.—Leinart Engineering Co. 412 E. 5th Ave.
LOS ANGELES 4, Cal.—Haskel Engineering & Supply Co. 721 W. Broadway, Glendale
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MEMPHIS, Tenn.—J. E. Dilworth Co., 730 South Third St.
MILWAUKEE 3, Wis.—Mormon Belting & Supply Co. 522 W. State St.
MILWAUKEE 4, Wis.—Wallace Cos. of Wisconsin 838 So. 6th St.
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NEWPORT NEWS, Va.—Noland Co., 27th St. & Virginia Ave.
NEW YORK 12, N. Y.—Nielsen Hydraulic Equipment, Inc. 298 Lafayette St.
NEW YORK 14, N. Y.—Whitehead Metal Products Co. 303 West 10th St.
PHILADELPHIA 40, Pa.—Whitehead Metal Products Co. 1955 Hunting Park Ave.
PITTSBURGH 33, Pa.—Williams & Co., 901 Pennsylvania Ave.
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SAN FRANCISCO 3, Cal.—General Machinery & Sup. Co. 1346 Folsom St.
SEATTLE 9, Wash.—Palmer Supply Co., 222 Westlake, N.
SHREVEPORT, La.—Standard Brass & Mfg. Co. 1557 Texas Ave.
ST. LOUIS 15, Mo.—Metal Goods Corp., 5239 Brown Ave.
SYRACUSE 4, N. Y.—Whitehead Metal Products Co. 207 W. Taylor St.
TOLEDO 2, O.—Williams & Co., 630 E. Woodruff Ave.
TULSA, Okla.—Ardun Supply Co., 317 S. Detroit
TULSA 3, Okla.—Metal Goods Corp., 302 North Boston
CANADA—Railway & Power Engineering Corp. Ltd.
EXPORT—Mercator Corp., 438 Walnut St., Reading, Pa.



How can you use STYRENE MONOMER?

• Koppers Styrene Monomer is a colorless, liquid, aromatic hydrocarbon in a state of high purity. Its chemical possibilities in polymers and copolymers have found wide application in the manufacture of polystyrene plastics and synthetic rubbers, including GR-S Rubber for tires and other rubber-styrene copolymers for shoe soles, floor tiles, rubber mechanical goods. Polystyrene and styrene copolymer latices are used in water base paints and in paper and other materials coatings.

Styrene Monomer is used also in the manufacture of styrene resins for the coating and impregnation of porous and fibrous materials, in the manufacture of polyester laminating resins, styrenated drying oils and styrenated alkyds for paints, enamels and varnishes, and in pour point depressors for lubricants.

Styrene Monomer is also a versatile chemical raw material, yielding organic intermediates useful for further chemical synthesis. Investigate it now. Styrene is supplied in tank-car, tank-truck, and 55-gallon drum quantities. Write for Bulletin C-1-119.

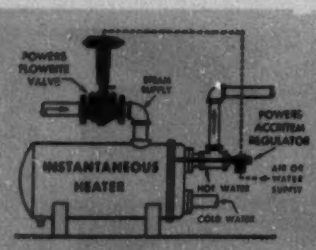
KOPPERS

Koppers Chemicals

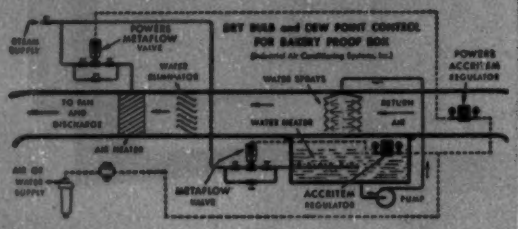
KOPPERS COMPANY, INC.
Chemical Division, Dept. CE-53, Pittsburgh 19, Pa.

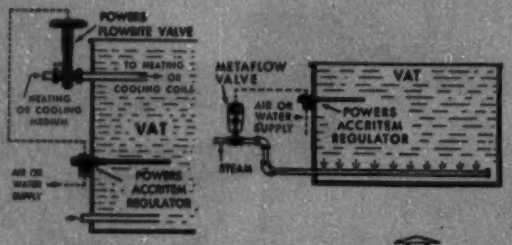
POWERS

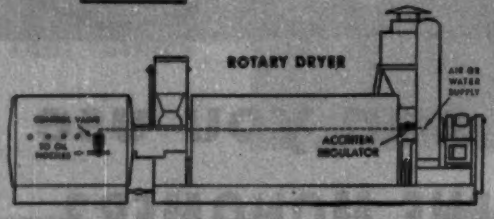
ACCRITEM REGULATOR

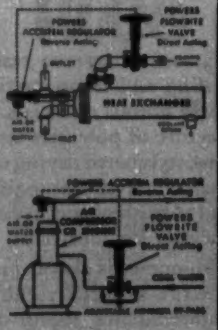


Only a few of many uses

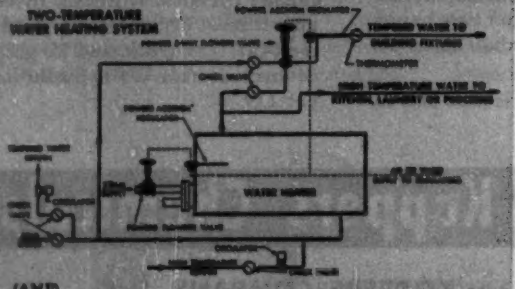














Gives

Accurate, Low Cost Heat Control

Use Accritem Regulators to control diaphragm operated valves or dampers. They save labor, stop losses caused by over-heating and have the following—

IMPORTANT ADVANTAGES

- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures many years of reliable service.
- ***Temperature Ranges*** 50 to 250° F. and 150 to 350° F.
- ***Easy to Install*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size***—regulator head is only 2⅞″ x 3⅝″, sensitive bulb is 12″ long with ½″ I.P.S. connection.

POWERS

FLOWRITE and METAFLOW
Diaphragm Valves
controlled by a POWERS
ACCRITEM HEAT REGULATOR
provide an unbeatable combination for *better control and lower maintenance*

Write for Bulletin 316—or phone our nearest office for prices and further information about POWERS ACCRITEM regulators and djaphragm valves.

THE POWERS REGULATOR CO.

OFFICES IN OVER 50 CITIES • See Your Phone Book
Factory & General Offices: SKOKIE, ILLINOIS
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Over 60 Years of Temperature and Humidity Control

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

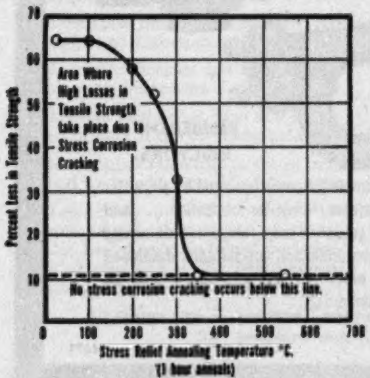
Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Preventing Stress Corrosion and Season Cracking of Condenser and Heat Exchanger Tubes, PART II

As mentioned in last month's Copper Alloy Bulletin, stress corrosion and season cracking generally result from the combined effects of the presence of ammonia in the atmosphere, the composition of the alloy and the magnitude of the stresses present in the tubing. The absence of any one of these factors prevents stress corrosion and season cracking from taking place. Consequently, the reduction or removal of stresses in the tubing is a preventive measure.

This can be effected by stress relief annealing. A temperature in the neighborhood of 200°C or higher is required for reduction or removal of such stresses. The stress relief annealing temperature varies with the alloy and extent of cold working.

Effect of Stress Relief Annealing Temperature on Stress Corrosion Cracking (Alternate Immersion in 15% normal NH_4OH Solution, 50% Hard Leaded Brass Tubing).



It is evident from this laboratory test that relief of stress begins at temperatures above 100° C and apparently is not complete until recrystallization occurs.

In the manufacture of condenser tubes such as Admiralty, Muntz, Aluminum Brass, and Aluminum Bronze, the tubes are cold drawn to the finished size. This is followed by annealing to remove stresses and to recrystallize the metal for the formation of the grain size called for in A.S.T.M. Specification B-111-52.

Copper and Arsenical Copper tubes are supplied in any one of the following tempers:

Light Drawn Temper
Hard Drawn Temper
Hard Drawn Temper End Annealed.

90-10 Cupro Nickel tubes may be supplied in either light drawn temper or annealed temper.

Copper, Cupro Nickel and Red Brass are more resistant to stress corrosion cracking than Admiralty, Muntz, and Aluminum Brass. The relative order of merit is as follows:

Copper
70-30 Cupro Nickel
80-20 Cupro Nickel
90-10 Cupro Nickel
Red Brass
Aluminum Bronze
Admiralty
Aluminum Brass
Muntz Metal.

The annealed condenser tubes are required by the A.S.T.M. specification to stand without cracking an immersion for 30 minutes in a 1 per cent mercurous nitrate solution. However, this test is not required for copper, arsenical copper and copper-nickel tubes because they are resistant to cracking in this solution.

Effects of Improper Handling

The ends of tubes may be injured through excessive expansion and hardening during roller expansion into the tube sheets. Expanding into enlarged or oversized holes in the tube sheets will stretch the circumference of the tube more than normally and may result in high residual stresses at the end of the roller-expanded section.

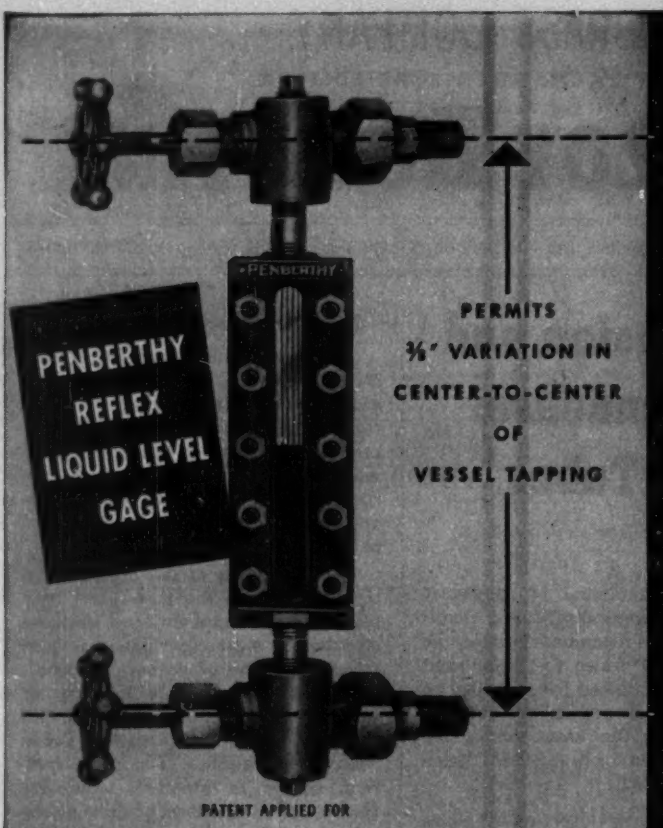
The expanding of the tube beyond the thickness of the tube sheet may also leave the metal with high residual stresses. In most environments these stresses will be of no serious consequence, but if ammonia, mercury, or mercury salts come into contact with the stressed brass, cracking may result soon after exposure. The most common source of ammonia emanates from the decomposition of slime on the tube surface particularly during a stagnant period such as when the condenser is not in operation. Trouble from this source during equipment shutdown can be minimized by thoroughly drying out the condenser tubes by blowing warm air through the unit or chemical treatment (such as chlorination) for the removal of slime or prevention of slime.

Effect of Liquid Metal on Stressed Tubes

Rapid intercrystalline penetration of brass and copper alloys by liquid metals such as mercury and molten solder may cause cracking. This is occasionally encountered in condenser and heat exchanger tubing. Such penetration can occur in a matter of seconds when the tube is bent or otherwise deformed or stressed before or during contact with the liquid metal. Liquid mercury sometimes finds its way into heat exchangers from mercury salts, originally present in certain crudes or from pressure measuring or control devices using mercury.

Bridgeport's Corrosion Laboratory is constantly investigating the behavior of metals and alloys under a wide range of conditions. Get in touch with the Bridgeport office nearest you for assistance in solving your condenser tube problems and meeting your special requirements. (9775)

"ADVERTISEMENT"



PENBERTHY "Floating Shank"

Saves Time and Money in Gage Installation

A feature available only on Penberthy drop forged steel (and alloy) gage valves, the "floating shank" automatically compensates for as much as 3/8" variation in the center-to-center distance of the vessel tapping. This saves time and cuts the cost of gage installation . . . eliminates stresses often induced during mounting. Penberthy "floating shank" is available at slight additional cost. It will pay you well to specify "floating shank" on your next gage order.

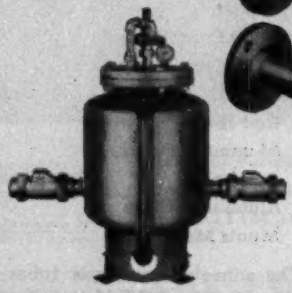
Another PENBERTHY First



OTHER PENBERTHY PRODUCTS

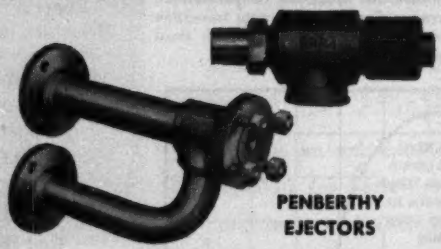
PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and/or temperatures. Exceptionally sturdy construction—liquid chamber machined from solid block of metal. Ask for Catalog 35.



PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

4671

PENBERTHY INJECTOR COMPANY

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

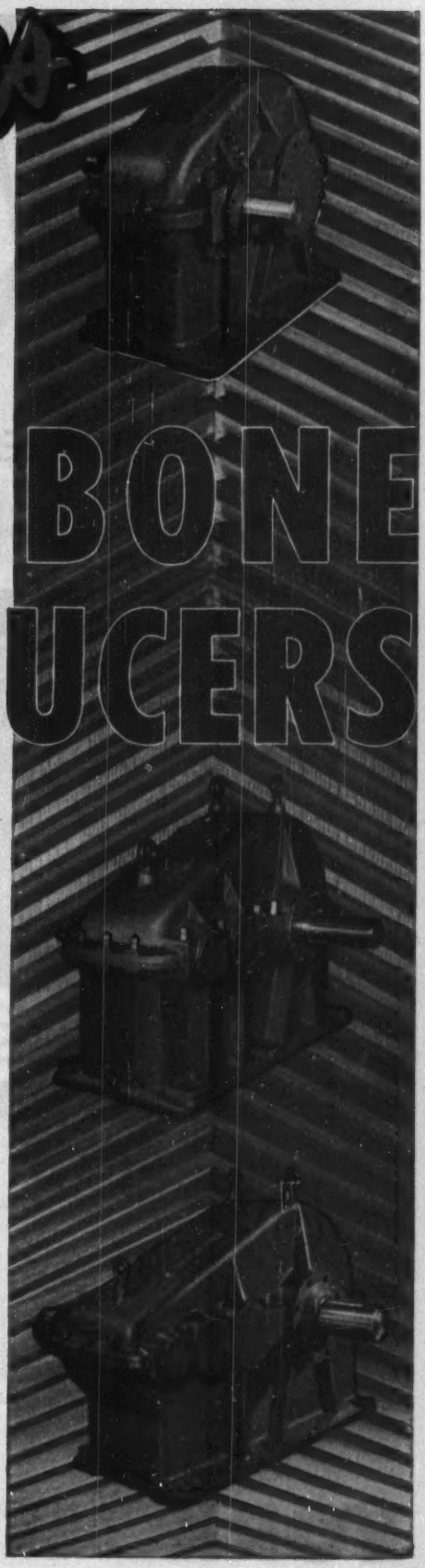
Established 1886 *Canadian Plant, Windsor, Ontario*

D.O.James

Established 1888

CONTINUOUS-TOOTH HERRINGBONE GEAR REDUCERS

The Gear with the Backbone



Some of the Many Proven *On-the-Job* Advantages of This Type of Gear Reduction Are as Follows

1. No side thrusts.
2. No avoidable deflections, distortions.
3. No necessity for bearings having thrust capacity.
4. Stronger teeth, due to the arch-like construction.
5. Greater load-carrying capacity due to utilization of the full width of face.
6. More silent and smoother action due to absence of distortion.
7. No impact stresses due to avoidance of sideways deflections.
8. Uniform load across face due to balanced thrusts of the opposing helices.
9. Better lubrication due to the oil film formed by "wedge action" of the teeth.
10. Less costly to produce due to the absence of side thrusts and no necessity for heavy sections to reduce deflections — also due to the simultaneous utilization of two cutting tools.
11. Can be substituted for straight tooth gears without any change in design of bearings or housings, or increase in face width, or alteration in pitch.
12. No axial float is necessary because the "V" shaped herringbone teeth wedge automatically into the mating gear thus eliminating all sideways motion and the consequent rubbing action of a screw-like nature existing in single helical gears which result in pitting and wear at relatively low loads.
13. Less expensive gear housings and bearing housings due to balanced thrusts.
14. Large helical angles are used; thus the full benefit of the helical principle is obtained.
15. Tooth deflection, though very small, results in the greatest load being carried by the strongest section.

All Gears are Generated Continuous-tooth Herringbone Gears, 20° pressure angle, 30° helix angle

Send for Catalog 40-C

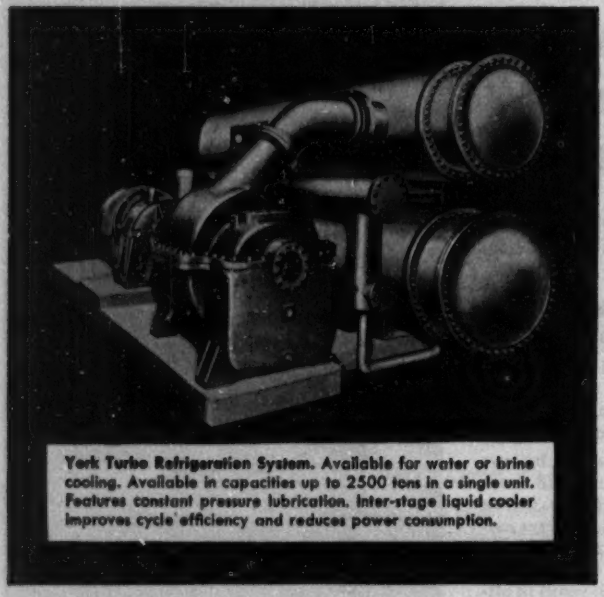
D.O.JAMES GEAR MANUFACTURING CO.

Since 1888 • Makers of Every Type of Gear and Gear Reducers

1140 W. MONROE STREET • CHICAGO 7, ILLINOIS

YORK'S FAMOUS T/S URBO SYSTEM

CAN HELP YOU BREAK THE V/P OLUME PROFIT PARADOX



York Turbo Refrigeration System. Available for water or brine cooling. Available in capacities up to 2500 tons in a single unit. Features constant pressure lubrication. Inter-stage liquid cooler improves cycle efficiency and reduces power consumption.

You'll Cut Costs With A York Turbo Refrigeration System

1. Low Operating Costs
2. Low Maintenance Costs
3. Compact for capacity produced
4. Vibration-Free Operation
5. Pre-rotation Vane Capacity Control

Formula for '53: To build profits, make cost-saving capital investments now. You know that from now on profits will depend on increasing production and cutting production costs.

This calls for equipment that can work harder, better, longer and at lower cost than ever before.

Here's what the York Turbo has to offer: *four (or more) compressors in one . . .* with York's *exclusive* Pre-rotation Vane Control. P.V.C. gives greater simplicity of control and wider operation range without "throttling" or pressure drop. Manpower and work hours are utilized more profitably because you can schedule your loads with complete flexibility. And for applications where accurate temperature control is paramount, the York Turbo is unsurpassed.

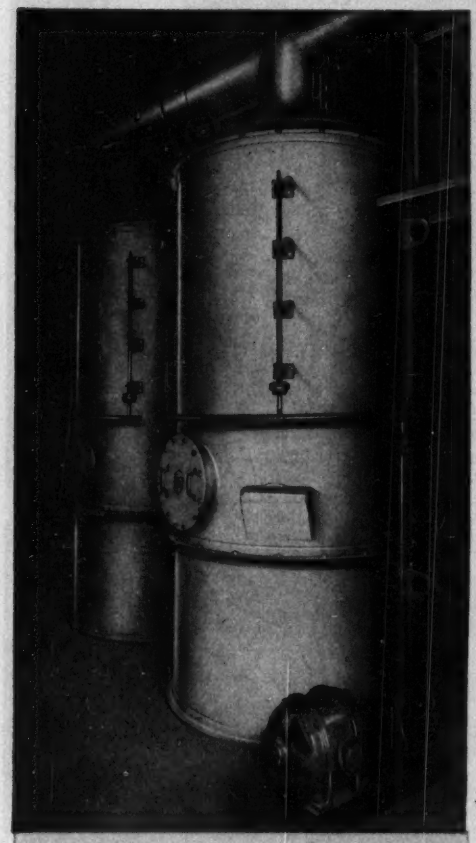
Contact the York Engineering Office nearest you. A consultation incurs no obligation, of course —may point the way to a more profitable operation, as it has for so many others. Or, if you prefer, write to York Corporation, York, Pennsylvania.

YORK REFRIGERATION AND AIR CONDITIONING

HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

DUST and FUME Control

Special equipment engineered to solve individual problems posed by dusts of all kinds, fly ash, chemical fumes, gases of any temperature, aerosols, and other troublesome air polluents



MAHON FOG-FILTERS AT WORK

The installation illustrated above was specially designed for the Motor State Oil & Grease Co., Jackson, Mich. PROBLEM: To eliminate H_2S odor from sulphonated grease manufacturing operations. The problem was complicated by grease and oil fumes present in H_2S gas. SOLUTION: A two-tower Fog-Filter connected in series was designed with high pressure water fog collecting practically all of the grease and oil fumes in the first tower. A caustic solution employed in the second tower and fogged at lower pressure removes the remaining H_2S from the air before it is exhausted into the atmosphere.

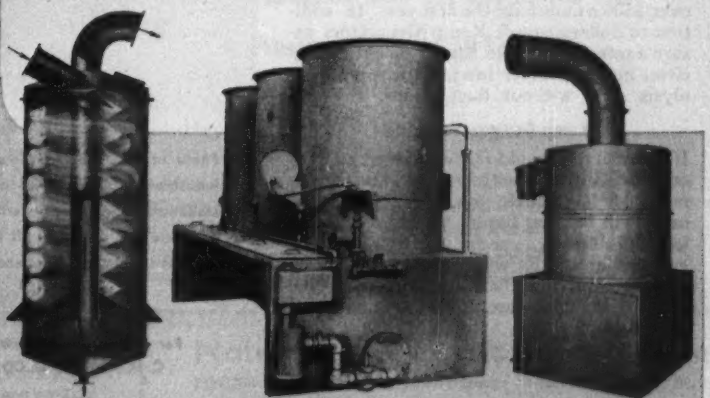
In dealing with air contaminants, each individual air cleaning problem must be approached with a view to determining what type of collector or filter is required to produce maximum results under existing conditions. Study and analysis of the character and extent of the polluent is therefore imperative in arriving at a satisfactory solution. Mahon dust and fume control engineers have, over a period of years, developed and perfected special Wet and Dry Collectors and Fog-Filters which have proved highly successful in coping with all types of industrial air contaminants—a few are illustrated here . . . they are serving today in some of the most difficult and mandatory air cleaning jobs in industry. Each installation has been engineered to do the specific job. If you have an air pollution problem, regardless of its character, it will pay you to call in a Mahon engineer and let him show you what Mahon equipment has done with like polluents under conditions comparable to your own. See Mahon's Insert in Sweet's Mechanical Industries File for further information, or write for Industrial Equipment Catalog A-653.

THE R. C. MAHON COMPANY

Main Plant and Home Office, Detroit 34, Michigan

Engineers and Manufacturers of Dust and Fume Control Equipment Including Cyclone Collectors, Hydro-Foam Collectors, Jet Trap Collectors, Hydro-Filter Collectors, and Fog-Filters and Cupola Stack Washers.

All Mahon Equipment is Erected by Mahon to Insure Complete Satisfaction.

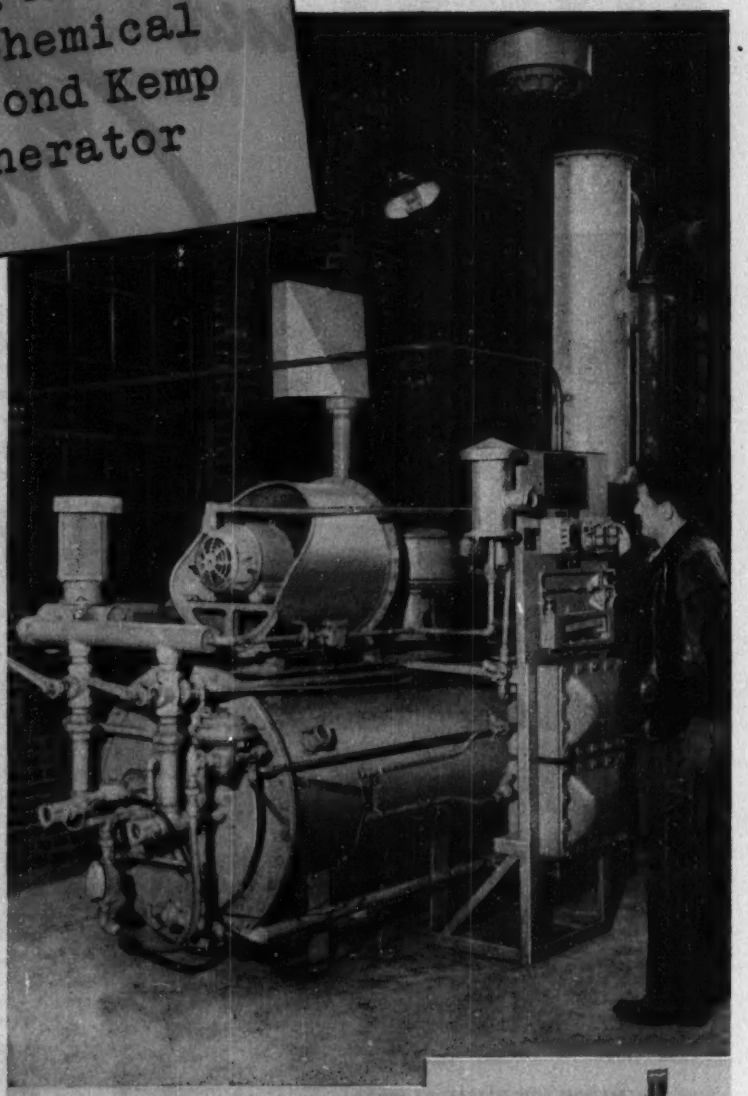


Fog-Filter **Hydro-Foam Dust Collector** **Jet Trap Dust Collector**

MAHON

Case No. 58

Results Bring Re-Order from Heyden Chemical Corp. for Second Kemp Inert Gas Generator



Heyden Chemical doubles its blanketing savings with Second Kemp Generator

HERE'S A CASE where simple mathematics paid big dividends at this Garfield, New Jersey plant. When Heyden Chemical—one of the nation's leading producers of formaldehyde, pentaerythritol, salicylic acid, etc.—installed its first Kemp Inert Gas Generator to furnish CO_2 for blanketing a special grinding operation, it was on more or less a test basis. Part of Heyden's constant search for newer, better, cheaper ways to improve its products. The rest of its blanketing needs were still being handled with CO_2 from large storage tanks in the plant.

Immediate Savings with Kemp

Results with the first Kemp Inert Producer were impressive. Now a second (see right) Kemp unit has been installed and actual savings over previous costs are estimated at over $500 a month for the first year. In addition to dollars saved, Kemp Generators assure a safe, dependable supply of chemically clean inerts. Deliver inerts at a special analysis . . . without fluctuations.

Kemp Designs Versatile

If you still rely on old-fashioned inert sources or are dissatisfied with present inert equipment, let Kemp help you, too. Kemp Engineers will be most happy to help solve your inert problems . . . show you how you can get similar results with fast-starting, easy-to-operate Kemp Generators. It costs you nothing to investigate. And it may save you real money.

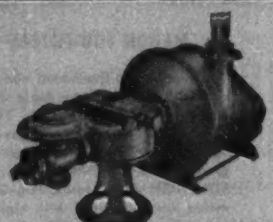
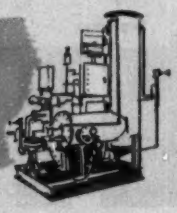


Photo at right shows close-up view of Kemp Industrial Carburetor. Part of every Kemp installation, it eliminates tinkering, waste. Assures complete combustion at all times. Reduces installation costs and maintenance.

For more complete facts and technical information, write for Bulletin I-10 to:
C. M. KEMP MFG. CO., 405 East Oliver Street, Baltimore 2, Maryland.

KEMP OF BALTIMORE

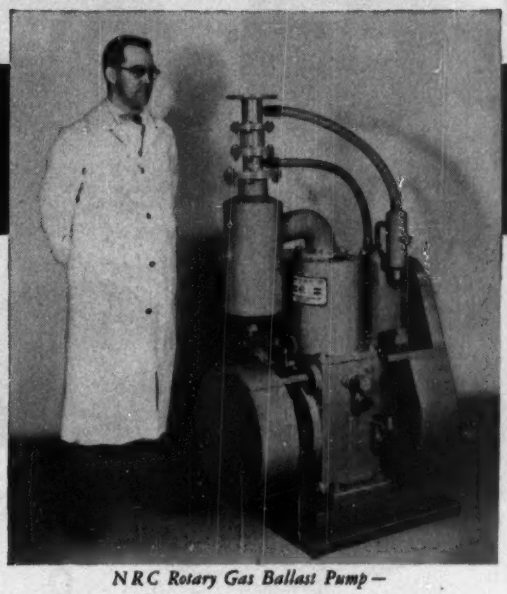


INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE
DRYERS • SINGEING EQUIPMENT

ROTARY HIGH VACUUM PUMP USERS:

End Your Water Vapor Troubles



NRC Rotary Gas Ballast Pump—
Model NRC 100M—a 2-stage pump unit

New—NRC High Vacuum Rotary Gas Ballast Pumps

- **Maintains fast pump down time**
- **Eliminates oil reclaiming units**
- **Provides greater capacity under 1 mm Hg**
- **Requires up to 80% less oil charge**
- **Capacities from 1¼ cfm to 400 cfm**
- **Pressures down to 10^{-4} mm Hg**

This is important news for every user of rotary vacuum pumps. At last, an "anti-water-vapor" pump that does not blank off at increasing pressures because it is trying to pump condensable vapors.

Water vapor is no problem to the new National Research Rotary Gas Ballast Pump. It operates on a principle that *prevents* the water vapor from condensing and contaminating the pump oil.

The pump is available in capacities from 1¼ cfm to 400 cfm; pressures down to 10^{-4} mm Hg; a full line of vane, piston-type and 2-stage pumps.

Send in the coupon today for your copy of the new bulletin that gives a full explanation of the Gas Ballast principle and complete engineering data on the construction and operation of the NRC Rotary Gas Ballast Pumps.

NRC

National Research Corporation
EQUIPMENT DIVISION, *70 Memorial Drive, Cambridge, Mass.*

Send me more facts about the NRC Rotary Gas Ballast Pump ☐ Have your Salesman call ☐

Name _____

Title _____

Company _____

Address _____

SPLASHING LIQUIDS

WITH

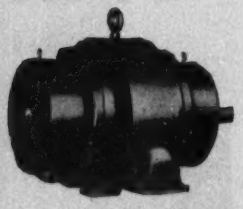
Century SPLASH PROOF MOTORS



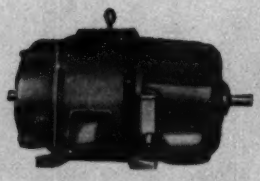
Century 7½ HP Type RS Single Phase Repulsion Start Induction Brush Lifting Splash Proof Motor.



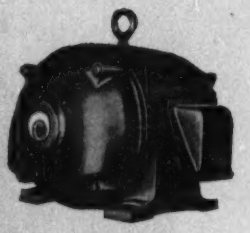
1 to 7½ HP Direct Current Splash Proof Motor.



150 to 400 HP Type SC Squirrel Cage Induction 3 Phase Splash Proof Motors.



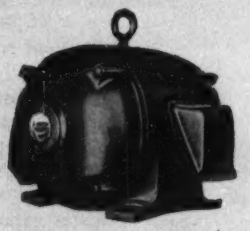
30 to 100 HP Type SR Slip Ring Induction 3 Phase Splash Proof Motors.



1 to 125 HP Type SC Squirrel Cage Induction 3 Phase Splash Proof Motors.



3 to 25 HP Type SR Slip Ring Induction 3 Phase Splash Proof Motors.



1 to 20 HP Type CS Capacitor Start Induction Single Phase Splash Proof Motor.

Keep the vital parts of your motors dry —even when the full force of a hose is turned directly on them. Century Splash Proof motors eliminate production losses due to dripping or splashing liquids or falling solids. They also protect against rain, snow, sleet or hail on outdoor installations.

Century Splash Proof motors are available in a wide range of types and sizes for all popular applications. Other types and ratings are available to meet your electric power requirements. You can specify Century motors with confidence.

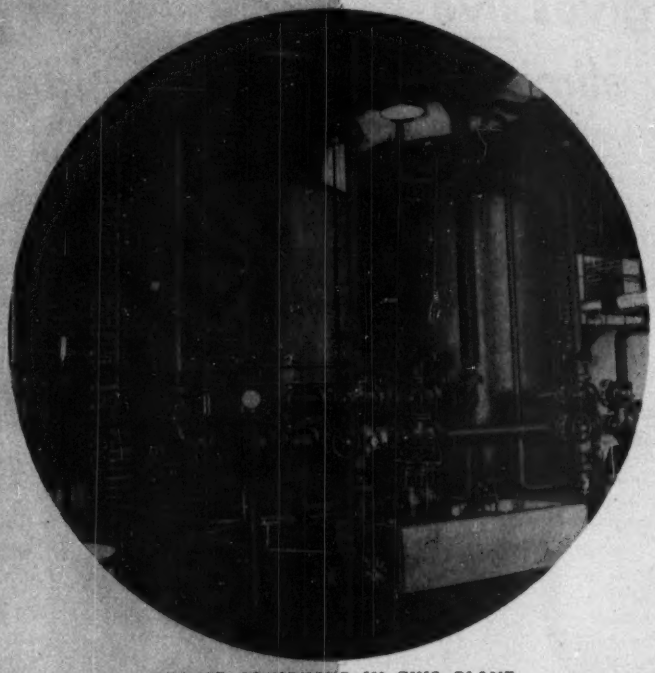
Century motors are built in sizes ⅛ to 400 horsepower.

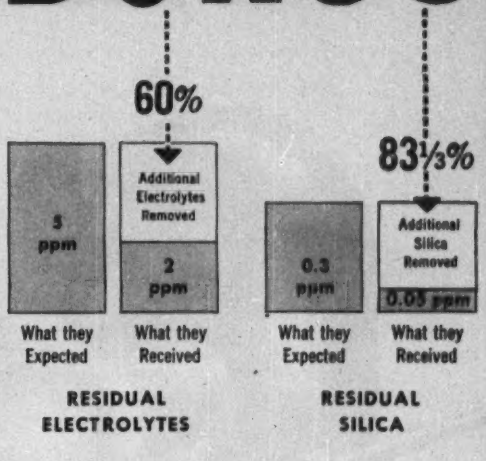
697

CENTURY ELECTRIC COMPANY, 1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

How this Demineralizer delivered a BONUS





GRAVER EQUIPMENT IN THIS PLANT

Two-bed demineralizer to treat 300 gpm of boiler feed make-up. Total capacity of softening plant per regeneration: 640,000 gallons, using Gravex ion exchange material. J. E. Sirrine Co., Consulting Engineers, selected Graver demineralizing equipment.

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14th STREET, NEW YORK 11, N. Y., Dept.

In Canada: The Bird-Archer Co., Ltd., Cobourg, Ontario
In Mexico: Proveedores Tecnicos, S.A., Puebla 259, Mexico 7, D. F.

If you wanted to reduce the total electrolytes in your raw water to *5 ppm*, and the demineralizing plant you installed actually reduced the electrolytes to *less than 2 ppm*, you'd have good reason to consider it a good investment.

And if, in addition, you expected the plant to reduce silica to *0.3 ppm*, and found that the silica was actually being reduced to *less than 0.05 ppm*, you'd have still more reason to consider that your demineralizer was delivering quite a bonus.

That's exactly what happened at the Riegel North Carolina Corporation's plant at Acme, N. C., without increasing the planned regenerant dosage. No wonder both the Company and its consultants consider the results very satisfactory.

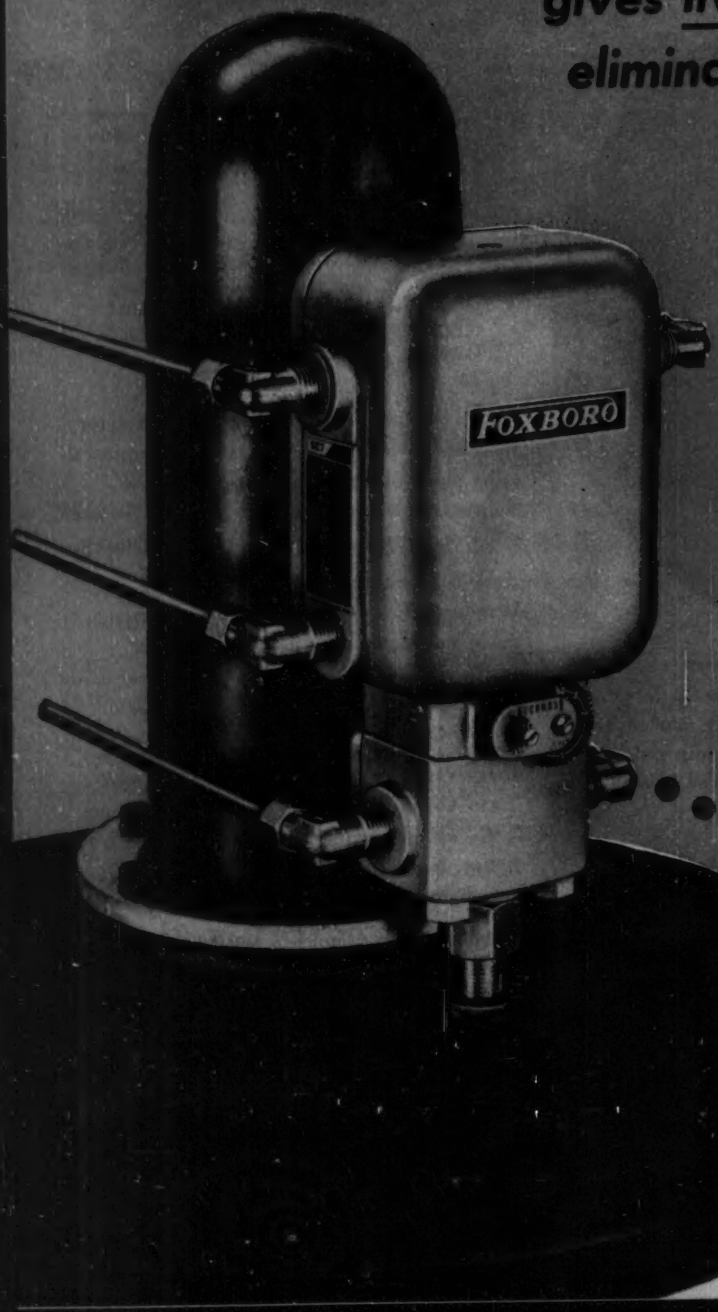
To be sure of a completely satisfactory water conditioning plant for your own needs, get the benefit of Graver's 40 years of specialized experience.

GRAVER *Demineralizers*

NOW CONTROL FLOW

M/59 Consotrol Controller

gives live-balance sensitivity, eliminates transmission lag.

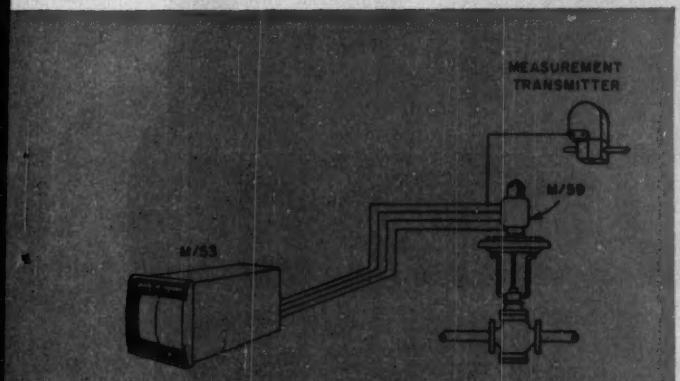


Designed specifically for *dynamic* control of flow, the M/59 Consotrol Controller takes full advantage of the speed and sensitivity of the Foxboro d/p Cell (flow transmitter). It is the direct result of Foxboro basic research into today's flow control problems.

This revolutionary flow controller combines inherently dynamic action with unique simplicity of design. Mounts directly on valve — no transmission line, no lag!

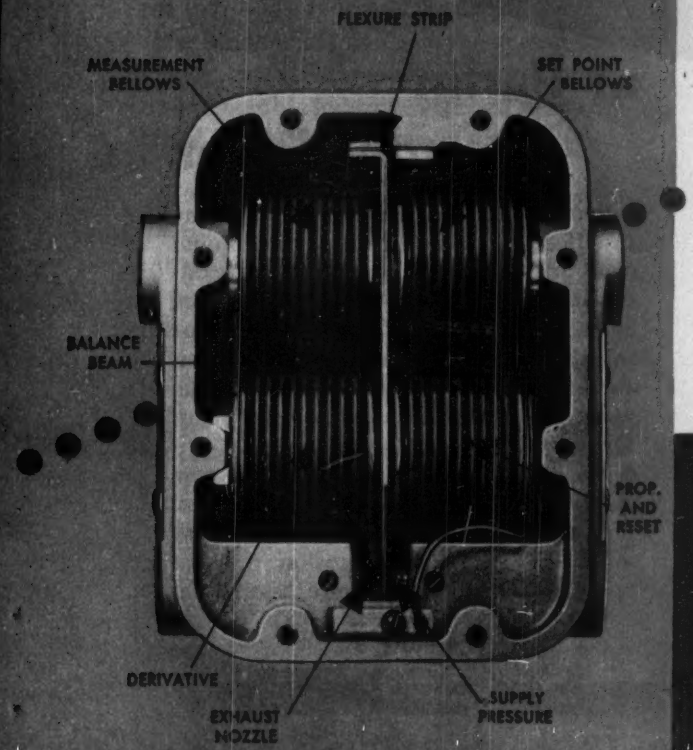
Write for Bulletin 470 which fully describes this outstanding development in flow instrumentation. The Foxboro Company, 365 Neponset Ave., Foxboro, Mass., U.S.A.

DYNAMICALLY



Schematic diagram shows the M/59 Controller as installed in conjunction with Foxboro d/p Cell and M/53 Consotrol Recorder.

- **Valve Mounted** — screws directly on valve motor with heavy duty stainless steel ¼" fitting . . . eliminates "lag" commonly caused by transmission lines.
- **Fixed Settings** — exclusive live-balance design of the M/59 Controller permits fixed proportional and reset values for all flow conditions . . . for all valve motor sizes. (Reset can be field-adjusted for special purposes.)
- **Response** — amazingly fast recovery with precise control regardless of load conditions and process upsets. No control point drift. Unaffected by vibration or wide changes in ambient temperature.
- **Seal Valve** — optional feature which permits isolation of controller and remote manual control of process. Integrally mounted to the bottom of the controller.
- **Maintenance-free** — nothing to align, nothing to wear out. Flexure strip fulcrum eliminates friction and wear of conventional type pivots. Tightly gasketed, completely weatherproof.



Unique Live-Balance Design

Photo of the M/59 with cover removed to show the exclusive, simplified live-balance mechanism. Balance Beam, which moves only a few thousandths of an inch to control the valve motor pressure, is flexure-pivoted and positioned between the four bellows. Any pressure unbalance between the set point and measurement bellows will change position of the Balance Beam. The proportional-reset bellows opposes such unbalance and prevents control point drift, while the fourth bellows provides the desirable amount of derivative action.

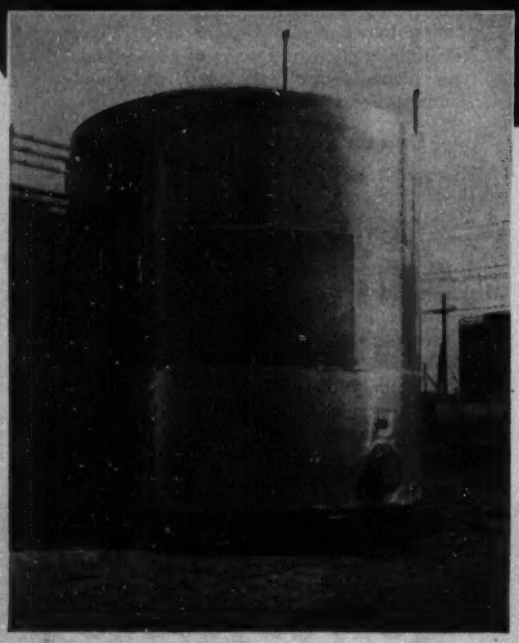
FOXBORO
REG. U.S. PAT. OFF.
INSTRUMENTS
INDICATING
RECORDING
CONTROLLING

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

for corrosion-resistant storage . . . it's



HORTON ALUMINUM TANKS



at Parlin Powder Plant

Recently, the Hercules Powder Company installed two more Horton* aluminum tanks at Parlin, N. J., for corrosion-resistant storage. The new tanks, 20-ft. diam. by 20-ft., are to be used for the storage of anhydride and acetic acid. Several Horton aluminum tanks for acetic acid storage were previously installed at the plant. These new installations are further evidence of the increasingly important part played by Horton structures in the chemical industries. For quotations on tanks of solid, clad, or lined corrosion resistant metals, write our nearest office. There is no obligation on your part.

Trademark registered in U.S. Patent Office

CHICAGO BRIDGE & IRON COMPANY

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Boston 10.....1005—201 Devonshire St.
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Cleveland 15.....2220 Midland Bldg.
Detroit 26.....1503 Lafayette Bldg.
Havana.....402 Abreu Bldg.
Houston 2.....2103 C&I Life Bldg.
Los Angeles 17..1505 General Petroleum Bldg.
New York 6.....3318—165 Broadway Bldg.
Philadelphia 3...1625—1700 Walnut St. Bldg.
San Francisco 4.....1522-200 Bush St.
Seattle 1.....1305 Henry Bldg.
Tulsa 3.....1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

BUFLOVAK

can help you solve processing problems— at a PROFIT

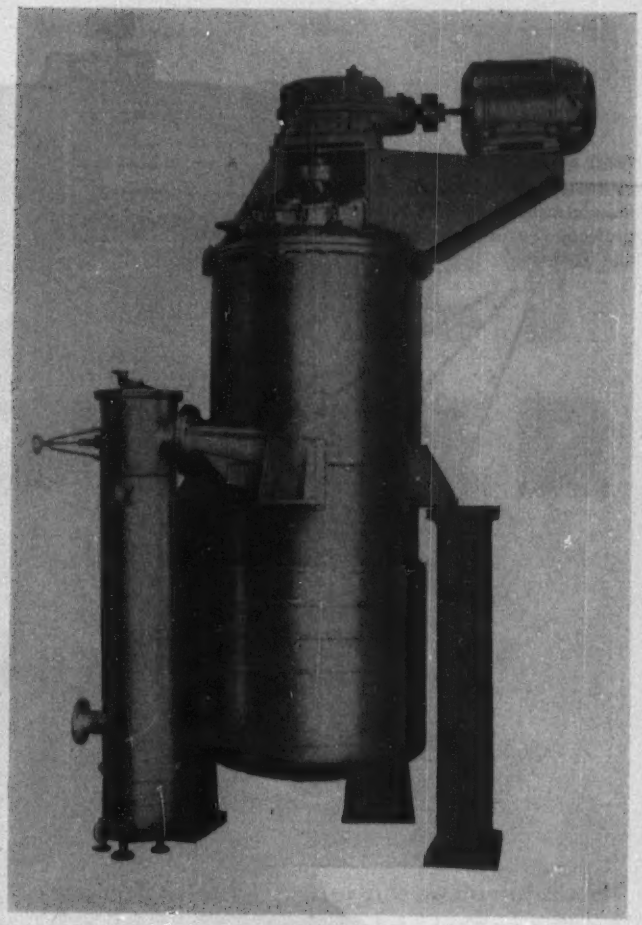
BUFLOVAK has helped another nationally-known manufacturer produce a better product at lower cost by combining two processes into one. That, of course, means greater profits!

A valuable, dilute, heat-sensitive solution is carried to high concentration in a single, compact unit. Ordinarily a two stage process would be required.

Special equipment was engineered for the job. A low-temperature, sanitary evaporator steamchest and a high vacuum processing kettle equipped with an agitator and selectable heating surfaces, were combined into a single, integral unit.

Through the combined facilities of our Research and Testing Laboratories, coupled with extensive field experience, BUFLOVAK Engineers design processing equipment for the most profitable results.

BUFLOVAK Catalogs have a wealth of valuable information on drying, evaporation and processing. A request on your company letterhead will bring copies to you.



A special BUFLOVAK Evaporator-Still which combines two processes into one.

BUFLOVAK Research and Testing Laboratory

To assist you in the solution of processing problems, BUFLOVAK offers the facilities of its Research and Testing Laboratory . . . where small scale experimental units show you, before you buy, the commercial possibilities, data on production costs, and characteristics of the finished product.

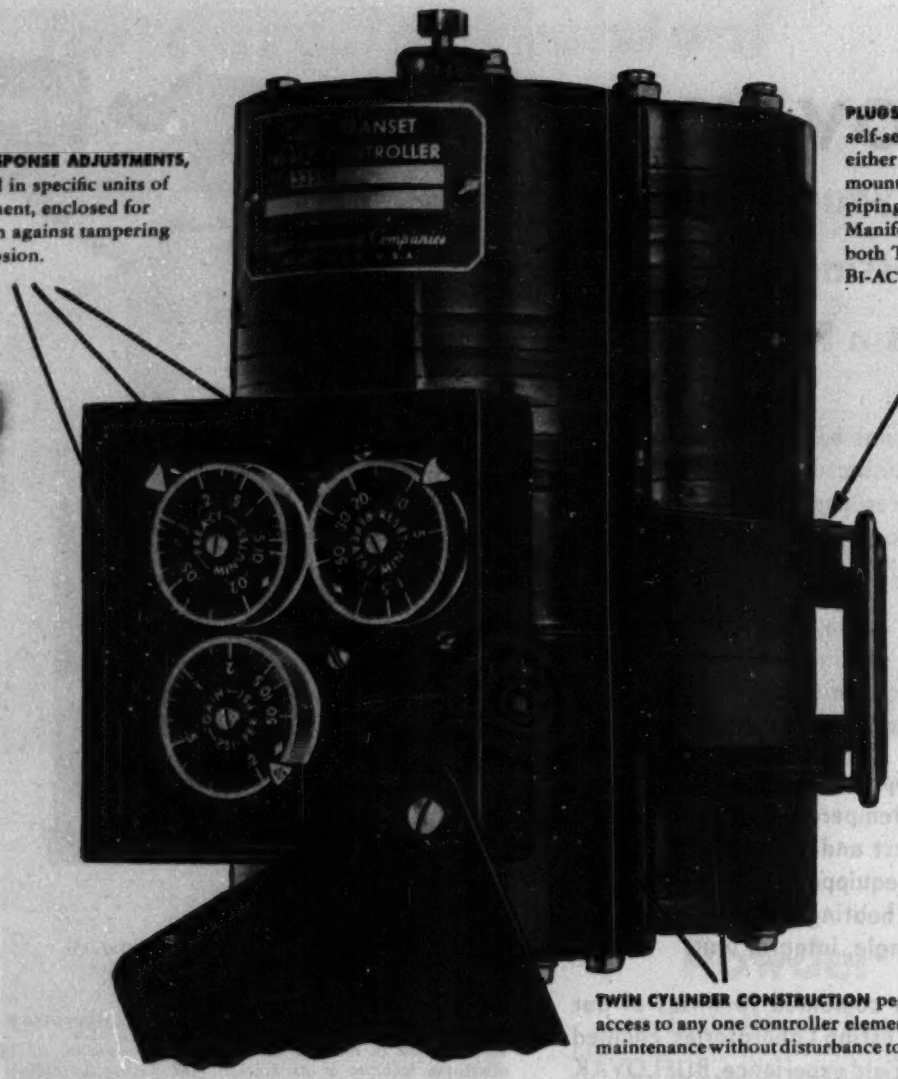
BUFLOVAK Processing Equipment

EVAPORATORS	DRYERS	PROCESSING KETTLES
Low-Temperature	Vacuum Double Drum	Mixers
By-Product Recovery	Vacuum Rotary	Impregnators
Chemicals	Pilot Plant	Dopp Kettles
Food Product	Atmospheric	Solvent Recovery &
Crystallization		Distillation Equipment

SEND FOR CATALOGS

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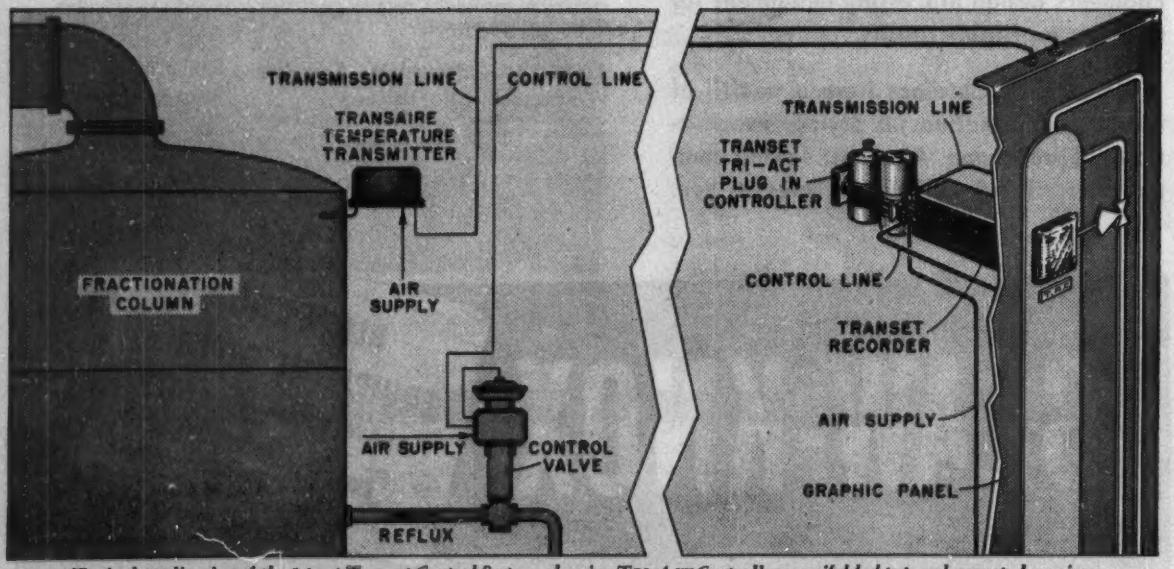
BLAW-KNOX
EQUIPMENT DIVISION
BLAW-KNOX COMPANY
PITTSBURGH 22
PENNSYLVANIA



THREE RESPONSE ADJUSTMENTS, calibrated in specific units of measurement, enclosed for protection against tampering and corrosion.

PLUGS IN to universal, self-sealing manifold for either panel or field mounting. Simplifies both piping and maintenance. Manifold accommodates both TRI-ACT and BI-ACT Controllers.

TWIN CYLINDER CONSTRUCTION permits quick, easy access to any one controller element for alignment or maintenance without disturbance to any other element.



Typical application of the 3 part Transet Control System, showing TRI-ACT Controller manifolded to panel-mounted receiver.

Brand New

TRI-ACT® CONTROLLER

The newest Concept in Process Control gives you:

1. Faster recovery on load changes
2. Start-up with no over-peaking
3. Benefits of automatic reset without its "evils"

THREE YEARS field experience proves new circuit principle not only sound but wanted more than ever. This unique force-balance controller capitalizes on faster speed of response of TRANSAIRE* measuring elements to give better control quality.

Easy Alignment. A fine thread gives a soft, vernier adjustment.

Settings "stay put". Permanent mechanical alignment. No one adjustment affects any other adjustment.

Pneumatically Stable. Practically insensitive to air supply variations. Gives wide range of settings in sensitivity (gain) and Pre-Act time (derivative) without upsetting stability.

Excellent Temperature Compensation — major construction refinements.

Interchangeability of TRI-ACT and BI-ACT* Controllers. Identical plug-in manifolds permit 10-second changeover with negligible process disturbance.

Die-cast Aluminum — light weight and corrosion resistant.

Response Adjustment Dials Totally Enclosed—full protection against tampering and corrosion.

Maintenance Simplified. Any one section of the instrument can be removed for servicing without disturbance to the remaining sections.

Buy one—try one on your toughest problem. There's no better way to prove the unprecedented performance of the TRI-ACT Controller.

Call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

Trade-Mark

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

GAS PURIFICATION

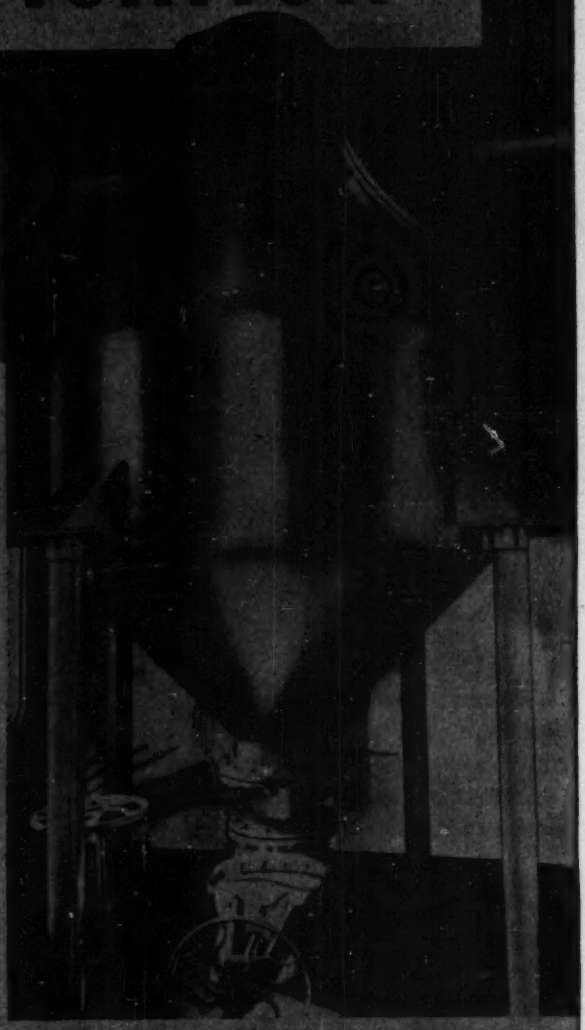
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REDUCED COST

Catalytic Operation at Low Pressure

DEOXO GAS PURIFIERS

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Typical Installation in Chemical Plant—150,000 CFH Deoxo Purifier

At Room Temperature—Removal of Oxygen and/or Hydrogen

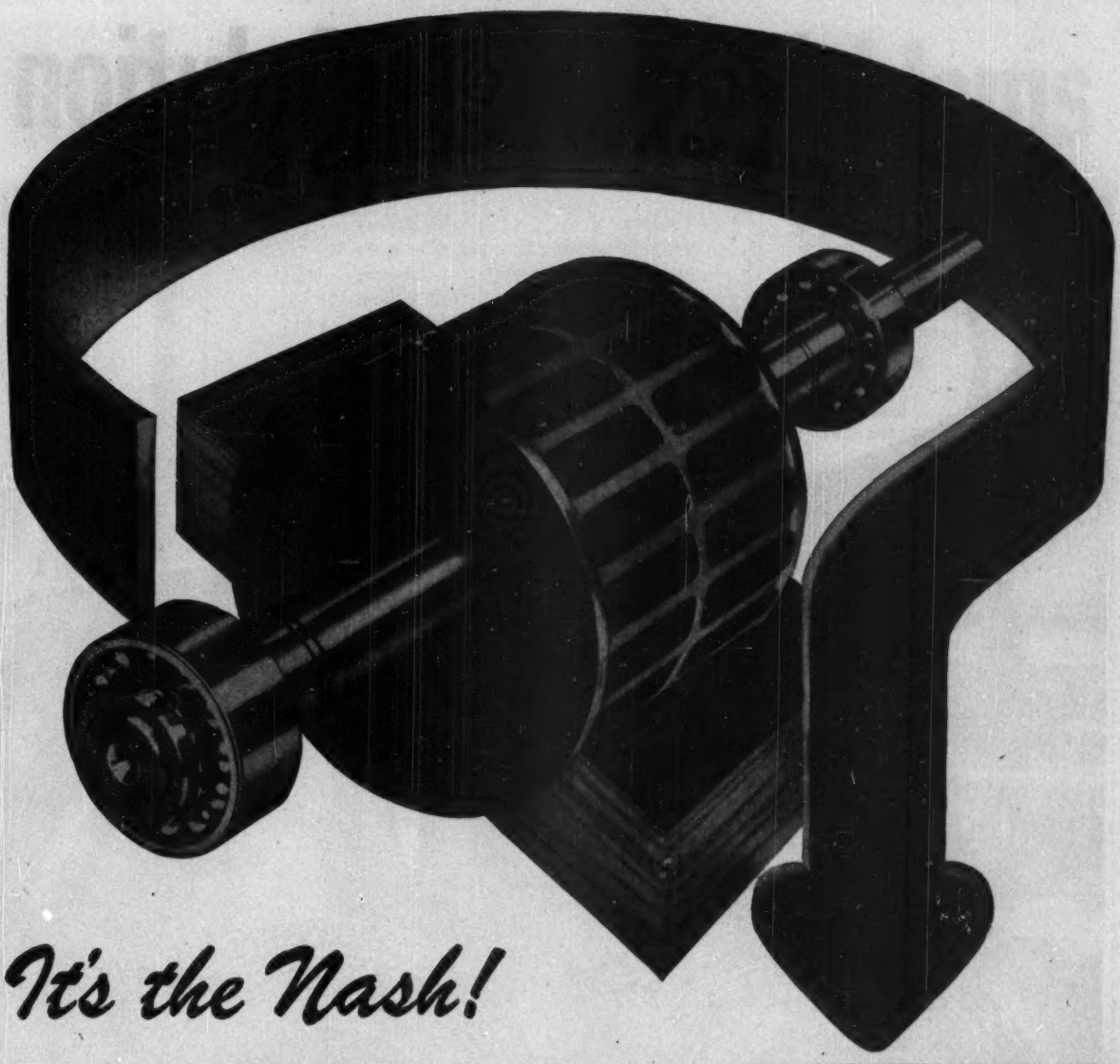
At 100° Centigrade—Conversion of CO to CO_2

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Available in Capacities of 25 CFH to 200,000 CFH

Baker & Co., Inc.

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It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

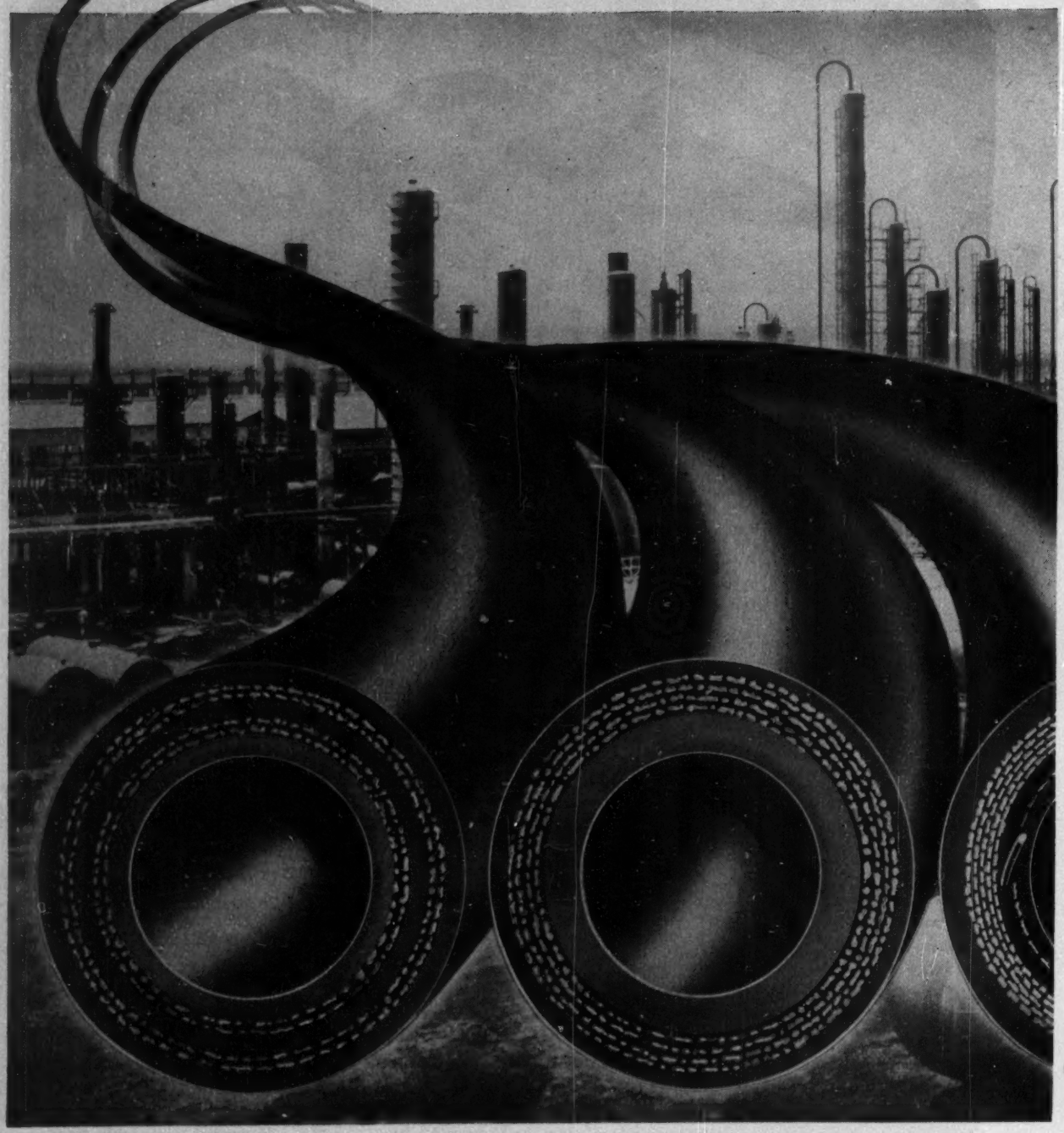
Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

No internal wearing parts.
No valves, pistons, or vanes.
No internal lubrication.
Low maintenance cost.
Saves floor space.
Desired delivery temperature Automatically maintained.
Slugs of liquid entering pump will do no harm.
75 pounds in a single stage.

NASH ENGINEERING COMPANY
312 WILSON, SO. NORWALK, CONN.

Three-way Solution

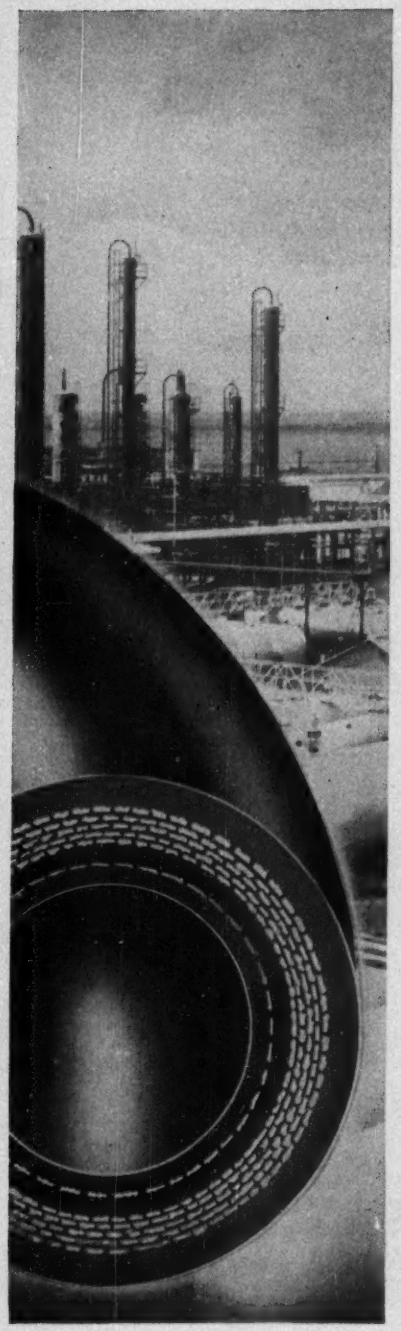


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HEWITT-ROBINS

DIVISIONS: HEWITT RUBBER • ROBINS CONVEYORS • ROBINS ENGINEERS

to Acid Handling Problems



Whether your problem is conductance of acids and chemicals under pressure, syphoning or suction or controlled flow . . . Hewitt Monarch Acid Hose is designed to give longer life at a minimum cost.

Here's proof: "Monarch® Acid Hose, handling bright nickel solution, the basic acid of which is Sulphuric Acid (Ph.2.5-3.0) has held up for five years." . . . "Monarch 2" 4-ply Acid Hose, in service approximately 2½ years has handled over 36 million gallons of Chlorate." . . . "Monarch Acid Hose, after 4½ years and handling over 50 million gallons of chlorine, still in service."

ENGINEERING DATA

TUBE: Pure gum rubber specially compounded to resist most acids and alkalies up to 50% concentration at temperatures up to 150°F . . . safely handles many acids at any concentrations.

REINFORCEMENT: Acid Conducting Hose—multiple plies of high-tensile cotton duck with insulating cushion of rubber between plies for increased flexibility.

ACID PINCH VALVE HOSE—two separate reinforcing walls of high-tensile cotton duck insulated from each other by a thick layer of pure gum rubber, provides maximum flexibility, assures greatest service life by eliminating crushing of duck by pinch bars when controlling flow.

ACID SUCTION HOSE—a helix of round spring wire between multiple plies of high-tensile duck provides resistance to suction forces . . . flexible, easy to handle.

COVER: Pure gum rubber designed to resist acids, alkalies and chemicals. Tough, to resist abrasion and cutting.

SIZES: All types available in ¾" to 12" I.D. and in tube thickness ⅛", 3/16" and ¼".

CHECK FOR INFORMATION ABOUT THESE JOB-TESTED PRODUCTS FOR YOUR OPERATION

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BELTING:
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HOSE:
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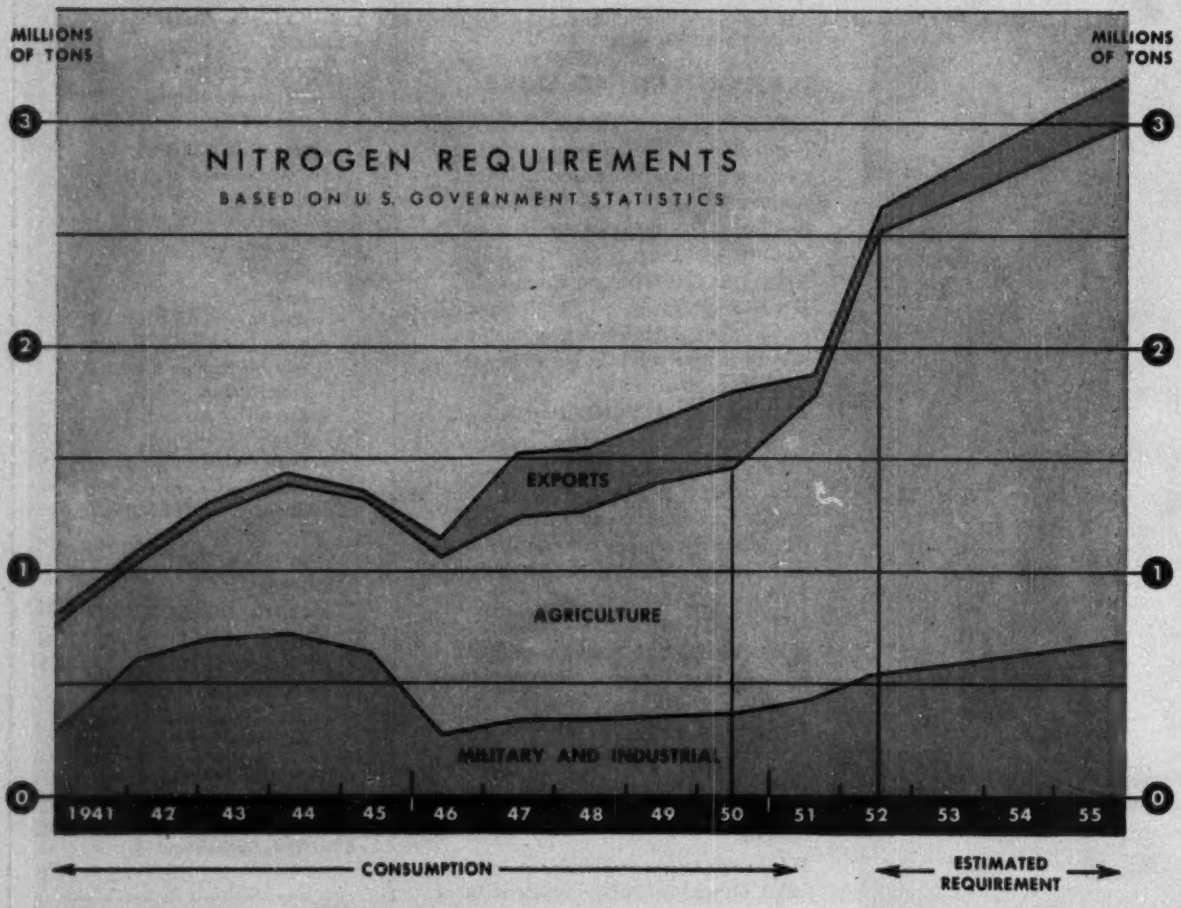
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If you are contemplating entering the fertilizer business or expanding your present facilities, you will do well to have Chemico handle your plant design and construction problems.

Regardless of whether your product will be urea, some other nitrogenous fertilizer or phosphate, we will handle your project on a one-contract, one-responsibility, performance-guaranteed basis.

The experience we have gained from more than 900 heavy chemical installations throughout the world is assurance of successful completion and efficient operation of your plant.



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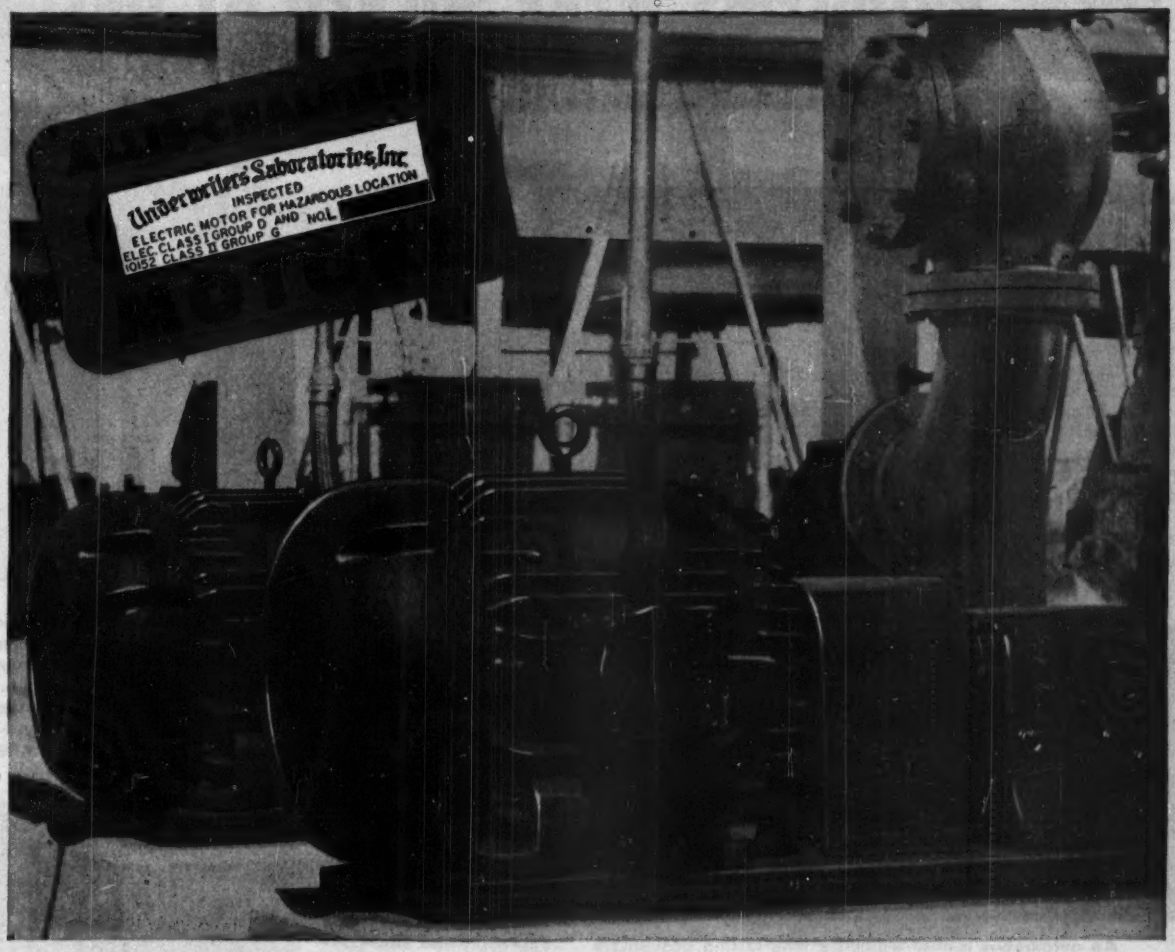
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No enclosed external air passages to clog. Easy to clean with cloth, brush, air hose or vacuum. Simply remove fan cover and whole radiating surface is exposed for inspection and cleaning.

2 Cast Iron Construction

Frame, conduit box and fan cover of cast iron resist corrosion. Fan is non-sparking, corrosion-resistant material. Well suited to outdoor operation.

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

3 Pre-lubricated Bearings

Ball bearings are double-shielded type, pre-lubricated at the factory. Periodic lubrication is not required under normal operating conditions, but provision is made for in-service lubrication if necessary.

GET COMPLETE INFORMATION on Allis-Chalmers motors for indoor and outdoor chemical plant service — complete with Allis-Chalmers coordinated control—from your nearby Allis-Chalmers Authorized Distributor or District Office, or write for Bulletins 51B7286 and 51B7149. Allis-Chalmers, Milwaukee 1, Wisconsin. A-4004

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CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.





PUMPS — Integral types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

THESE PROBLEMS WERE SOLVED BY ORLON
—What can it do for you?

A maker of carbon black had a money-losing operation. Problem: To recover a new carbon black of very fine particle size. Too many particles escaped with usual dust-collecting methods. Ordinary filter bags were then tried. They developed holes from the acid fumes. Solution: Bags of acid-resistant "Orlon" acrylic fiber. They made it possible to recover carbon black that had previously been lost; made this process profitable.





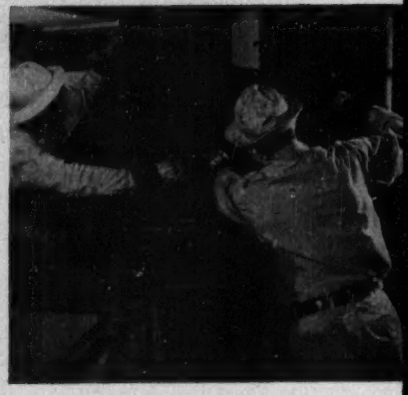


Battery workers' clothes were being eaten by acid. The work clothing at left was ruined in two weeks' time. That on the right has been in use four months, and is likely to be good for at least a year more of service. It withstands acid conditions because it is made of "Orlon." Uniforms of "Orlon" are popular, too, with service station operators, plant guards, and delivery men. Adding to the advantages found in work clothing, they offer easy launderability and press retention.

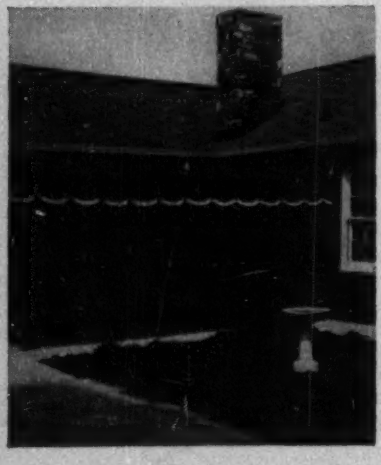


An automobile maker wanted a long-lasting convertible top. In topping fabric of "Orlon," he found one that will keep its good looks for years. A top of "Orlon" is more resistant to the weakening effects of the sun's rays than any fabric top ever used before. It holds its shape better, stands up well after repeated raising and lowering, and is easy to clean.

A filter-press operator had shutdown-time worries. Acids involved in wet filtration ruined his filter fabric in a very short time, and it was expensive and time-consuming to replace it. Then he installed a filtration cloth of "Orlon." It lasted 90 times longer than the cloth previously used. Only a fabric of "Orlon" could withstand the conditions of acid, heat, and unusual flexing involved in this process.



An awning maker wanted to give his canvas goods more strength at the seams. What was needed was a sewing thread that could resist weakening by sun, stress, mildew and insects. Tough, weather-resistant sewing thread of "Orlon" solved the problem. It not only produced seams of greater strength, but it gave them better looks. "Orlon" is also being used in the manufacture of sails, where its shape-retaining and weather-resistant properties are extremely useful.



HOW CAN YOU USE ORLON?

Your business, too, may benefit from the unique combination of properties found in "Orlon." Perhaps these case histories will suggest to you a new use for Du Pont "Orlon" acrylic fiber. If you have an idea for improving a product or production process with "Orlon," write E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Department, Room N-2522-C, Wilmington 98, Delaware.

ORLON is Du Pont's trade-mark for its acrylic fiber.
REG. U. S. PAT. OFF.

Many textile mills make fabrics of "Orlon" acrylic fiber—made and supplied to them by Du Pont. Look for its extra values in more and more products for industry.

DU PONT
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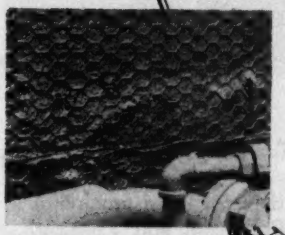
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Now—
fast insulation protection

Laykold®
ASPHALT SPECIALTIES

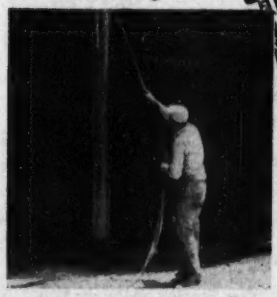
WEATHERCOAT
sprays on!

—in one-third the time required for troweling

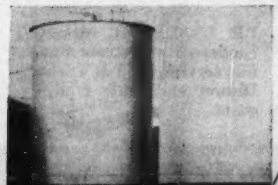




- **FIRST COAT** bonds and protects wire netting.



- **SPRAY GUN** applies second coat, too, in fastest possible time.



- **TRIPLE-SEALED** and smooth, after wet brooming.

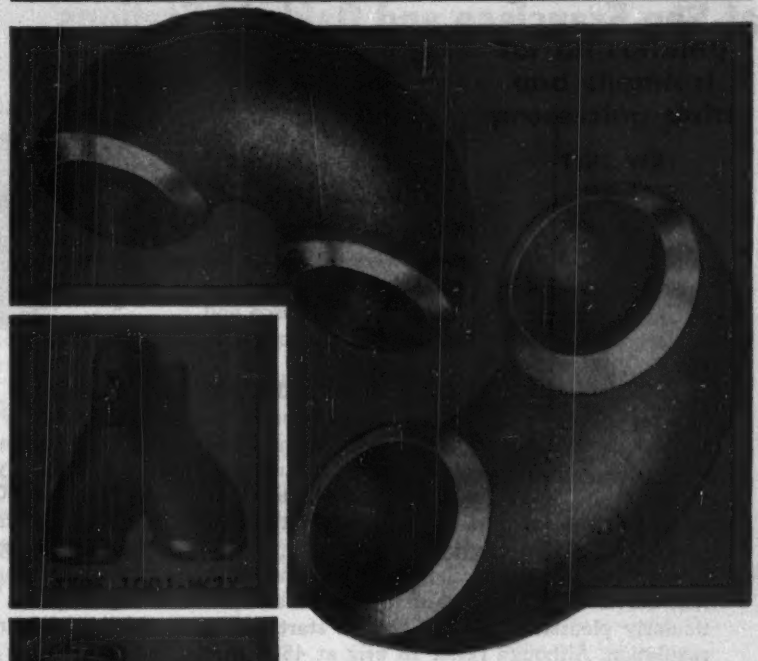
WEATHERCOAT—the standard of quality in the industry—for lasting protection.

AMERICAN Bitumuls & Asphalt COMPANY

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WELDING-TYPE FITTINGS



CAST WELDABLES GIVE YOU:

1. Lower cost
2. Longer life
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4. Heavier walls

They can be furnished for all tube and pipe sizes, and I.D. and wall thickness; on close center dimensions; from any type of cast material.

IMPORTANT. In your specifications send us: I.D. of tube; O.D. of tube; operating conditions; inlet and outlet pressures and temperatures; center dimensions.

Three of the welding fittings shown here have cleanout or inspection openings equipped with Ohio Type 1000 closures. Other closures are available.

The Ohio Steel Foundry Company

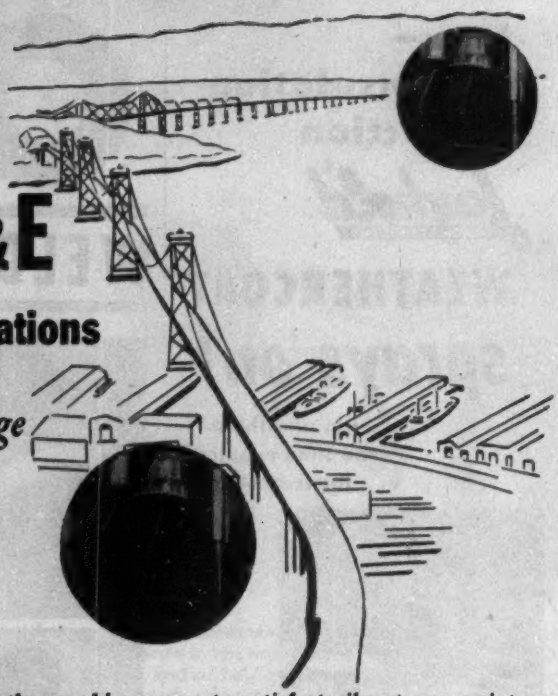
LIMA, OHIO

PLANTS AT LIMA AND SPRINGFIELD, OHIO

I-R Blowers assist in delivering

PEAK LOADS for PG&E

at San Francisco and Oakland Stations



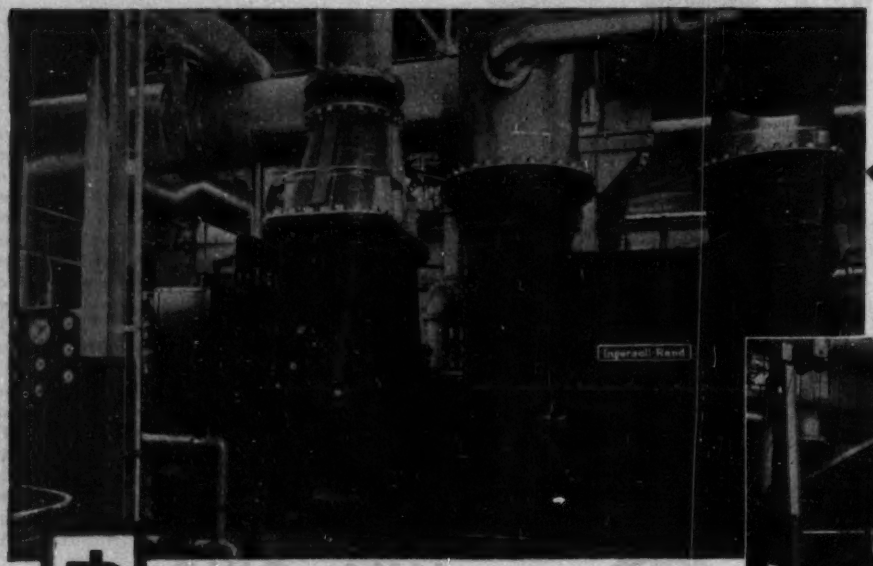
Units are giving excellent wide range performance in Gas Booster Service

To meet increasing peak loads in the Bay Area, two Ingersoll-Rand Turbo-Blowers were installed two years ago by the Pacific Gas & Electric Co.—one at the Potrero Station in San Francisco and the other just across the Bay at Station B in Oakland.

These I-R Blowers (rated at 30,000 and 12,500 cfm respectively) are being used to expand the company's intermediate pressure system. Their installation was primarily an economic measure since they are used as substitutes for additions which would otherwise be required in the high pressure 50 to 60 psig system.

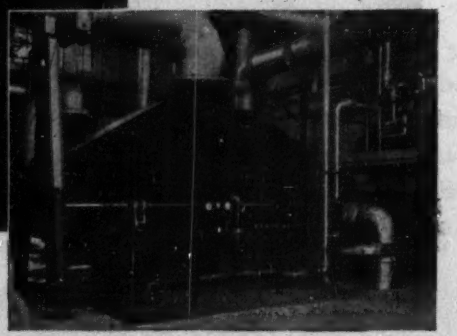
Both Ingersoll-Rand Blowers are giving excellent service and the station operators are particularly pleased with their ease of starting and regulation. Although rated 18 psig at 4500 rpm, the machines operate satisfactorily at any point on the curve down to 1500 rpm and 1.5 psig.

For year round dependability and wide range performance you can depend on Ingersoll-Rand Blowers for Gas Booster service—or any other blower application. Your I-R representative will be glad to help you select the equipment best suited to your particular air and gas handling requirements. His long experience in this specialized field may help you reduce costs all along the line.



I-R gas booster at Potrero Gas Station of Pacific Gas & Electric Co. Four-stage unit is driven by a 2,395 hp turbine at 4,500 rpm.

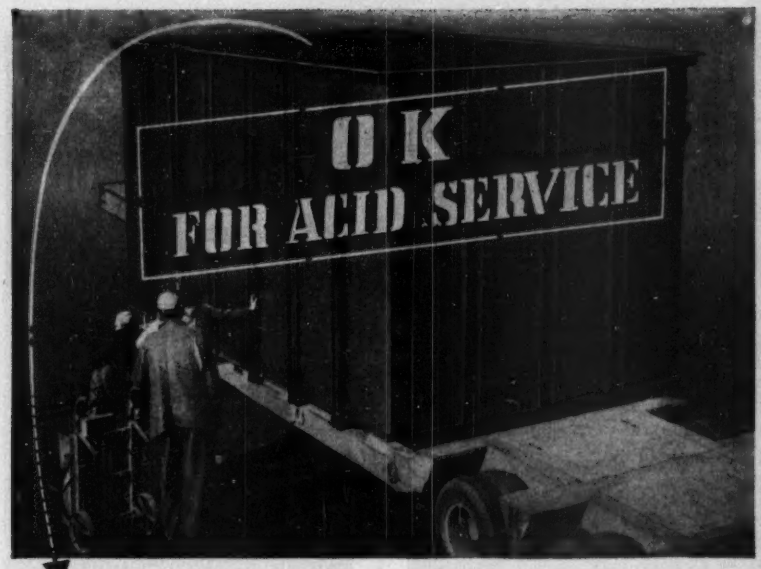
I-R 3,370 sq. ft. surface condenser at Potrero Station serving the I-R Turbo Blower and other equipment.



Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 818-12

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES





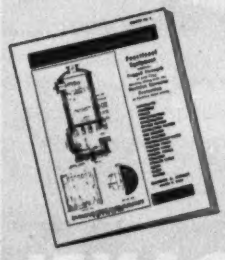
Pyroflex sheet lining is heat bonded to steel tank shell.

The acid storage tank above is "OK FOR ACID SERVICE" because it is Pyroflex constructed. It has been lined in our plant with a corrosion-proof heat-bonded Pyroflex membrane. Upon installation at job site, one course of acid-proof brick set in Knight No. 2 Acid-Proof Cement will be installed over the Pyroflex membrane.



Upon installation at job site, one course of Acid-Proof Brick is set in Knight Acid-Proof Cement.

Although this type of lining is typical of Pyroflex constructed tanks, Pyroflex construction is not limited to any specific materials. It may include steel, Knight-Ware, Permanite, rubber, lead, glass, carbon or whatever other material is best suited to individual service conditions. Thus each Pyroflex constructed unit is individually engineered for the job it must do.



Send for Illustrated Bulletin No. 2, "Pyroflex Constructions."

Chlorinators, drying towers, scrubbers, tanks and other types of Pyroflex constructed equipment are in wide use in the chemical and steel industries and wherever corrosion-proof equipment is required. Get the complete story — send for Bulletin No. 2, Pyroflex Constructions.

Maurice A. Knight 105 Kelly Ave., Akron 6, Ohio
Acid and Alkali-proof Chemical Equipment

HIGHEST

GPM*

RATING



***GPM** equals Gallons Per Manhour . . . how many gallons a pump can handle per manhour of maintenance. By this yardstick, Kinney Model SD Rotating Plunger Pump rates high. For example, a Kinney SD Pump has been in service for over 24 years handling glue in the plant of a paper specialties company and has been overhauled only once during that period. Kinney SD Pumps have earned their reputation for long-lasting dependability by delivering full rated capacity over long periods of time and under the toughest operating conditions. Kinney engineers will be glad to show you facts and figures . . . new ways to get new economy in your pumping operations. Kinney Manufacturing Company, Boston 30, Mass. Manufacturers of Vacuum and Liquid Pumps. Representatives throughout the United States and in foreign countries.

SEND COUPON FOR DETAILS!

Kinney

SUBSIDIARY OF THE NEW YORK AIR BRAKE CO.

Kinney Manufacturing Co.
3551 Washington Street
Boston 30, Mass.

Please send Bulletin L51 describing Kinney Liquid Pumps. My liquid pumping problem involves:

Name

Company

Street

City

State

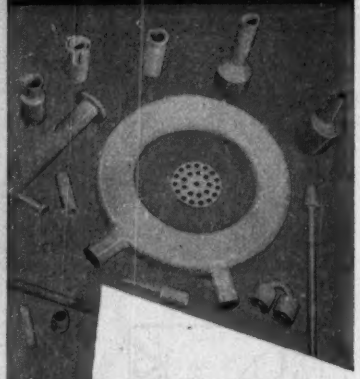
STANDARDAIRE
BLOWERS



move more air
with less wear—
less maintenance
and power costs
THAN ANY OTHER BLOWER
OF EQUAL WEIGHT, SIZE
OR COMPARABLE DESIGN

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CORPORATION
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McDANEL
HIGH TEMPERATURE
PORCELAIN
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for Every
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Purpose

Precision-made McDanel flasks, crucibles, combustion tubes, zirco tubes and other standard and special laboratory items are outstanding in quality and performance.

McDanel High Temperature Specialties undergo the most exacting inspections and checking at every stage of design and manufacture. They are trust-worthy. They have proved themselves by their record of more than 34 years' service in nation's leading laboratories.

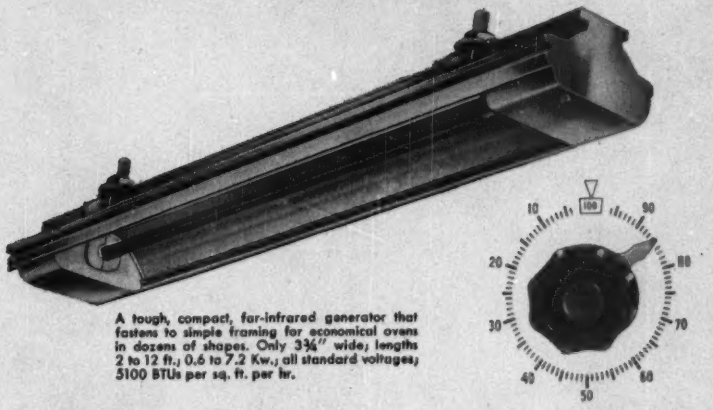
MILL LINING
SPECIAL
SHAPES
TANK LINING



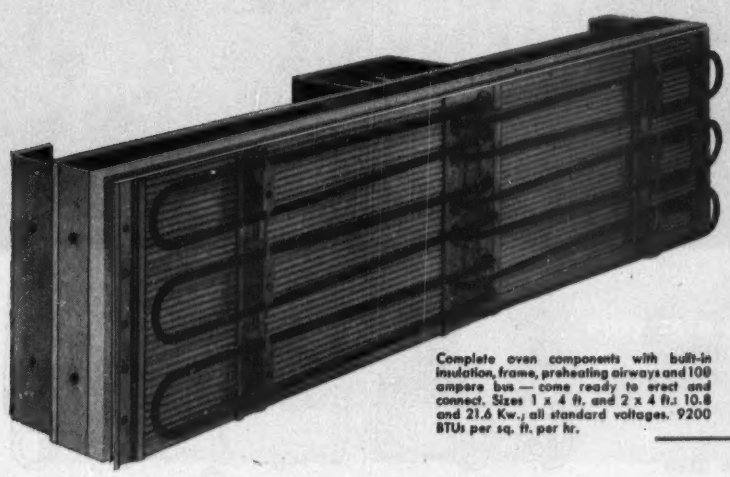
WRITE FOR "INDUSTRIAL PORCELAIN" CATALOG

McDANEL
REFRACTORY PORCELAIN CO.
BEAVER FALLS, PENNA.

uniform heat . . .
precise heat . . .
fast heat . . .
"**color blind**" heat . . .



A tough, compact, far-infrared generator that fastens to simple framing for economical ovens in dozens of shapes. Only 3¾" wide; lengths 2 to 12 ft.; 0.6 to 7.2 Kw.; all standard voltages; 5100 BTUs per sq. ft. per hr.



Complete oven components with built-in insulation, frame, preheating airways and 100 ampere bus — come ready to erect and connect. Sizes 1 x 4 ft. and 2 x 4 ft.; 10.8 and 21.6 Kw.; all standard voltages. 9200 BTUs per sq. ft. per hr.

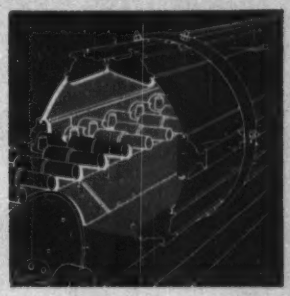
A Chromalox Electric Radiant Panel or Chromalox Radiant Heater installation gives you a quick, low-cost answer to your baking, curing, drying and other heating needs. Pre-engineered units allow on-the-spot erection and connection. You get up to 700° F. work temperatures; absolutely uniform radiation with no hot and cold spots; high intensity heat that's absorbed *f-a-s-t* by all colors; and accurate "dialed" heat from 0 to 100% of capacity.

CHROMALOX *Electric*

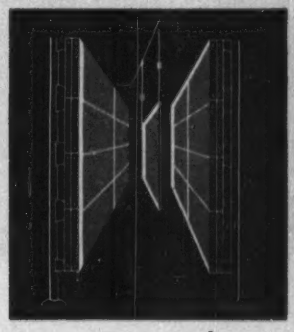
Far-infrared Units

TWO JOB-PROVED FAR-INFRARED TYPES TO CHOOSE FROM!

You'll find Chromalox pre-built Radiant Panels and Heaters from stock fit your jobs and your budget. Shown below are just two of the literally hundreds of oven shapes and sizes which can be erected quickly and easily using Chromalox Electric Radiant Units.



Conveyorized oven built on the job using Chromalox Radiant Heaters. Units are installed in lengths and ratings needed to fit the work. Input controller gives precise and exact temperatures easily adjusted to meet varied processing requirements. Easy to assemble, easy to wire.



Chromalox pre-engineered Radiant Panels are easily and quickly erected and connected to form ovens and drying tunnels of any size and shape. An oven such as sketched may be installed in 20 to 30 man-hours with minimum engineering expense and lowest cost per installed kilowatt.

Have a Problem Involving Degreasing, Drying, Baking, Preheating, Curing?

The assistance of Chromalox Application Engineers is yours for the asking. They'll help you work out your specific requirements without obligation. Write today.

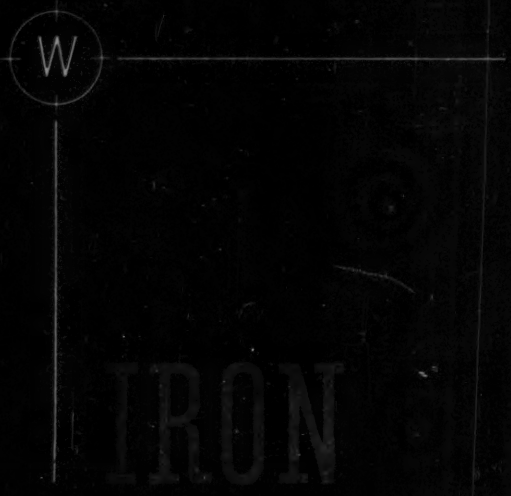
EDWIN L. WIEGAND CO. IC-75
7514 Thomas Blvd., Pittsburgh 8, Pa.

I'm interested in electric heat for.....
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☐ Send me Bulletins on Far-infrared units.
☐ Have a Chromalox Application Engineer get in touch with me.

Name.....
Company.....
Street.....
City.....Zone.....
State.....



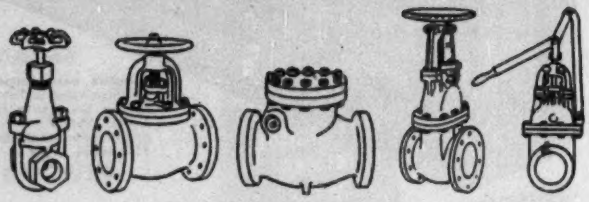


COMPLETE LINES OF IRON VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns for general industrial use.

Walworth also manufactures complete lines of valves (including Lubricated Plug Valves), and pipe fittings made of steel, bronze, and special alloys.

These valves and pipe fittings, plus Walworth-made pipe wrenches total approximately 50,000 items and are sold through distributors in principal centers throughout the world.

Walworth engineers will be glad to help you with your problems. For further information call your local distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.



Iron valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 726F Standard Iron Body, Bronze Mounted, Wedge Gate Valve with flanged ends. This line of valves is available in sizes 2 to 30 inches. Similar valves of All-Iron type are also available.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

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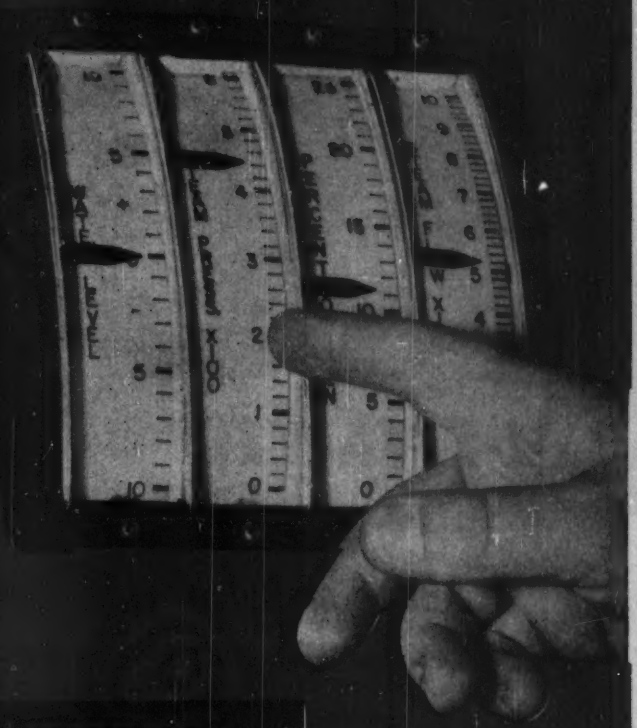
a new miniature indicator!

MEASURED VARIABLE — AIR-PILOT — COPPER TUBING

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ELECTRICAL TRANSMISSION



removable units—
interior illumination

easy to read—5 inch
scale, no parallax

easy correlation of
related functions

easy zero check
from the front

HAYS Miniscale Gages

This miniature instrument is especially suited for remote indication of such variables as pressure, draft, flow or level.

The scale is only 5 inches long — easy to read — internally illuminated. Choice of pneumatic or electric transmission.

Also available is the Hays direct reading miniscale gage for indicating *pressures* of fluids (steam, water, gas, oil, etc.) directly.

Gages are arranged for flush or semi-flush mounting. Either a yoke mounting, for as many as 12 units, or a keyhole clamp mounting for individual units can be provided.

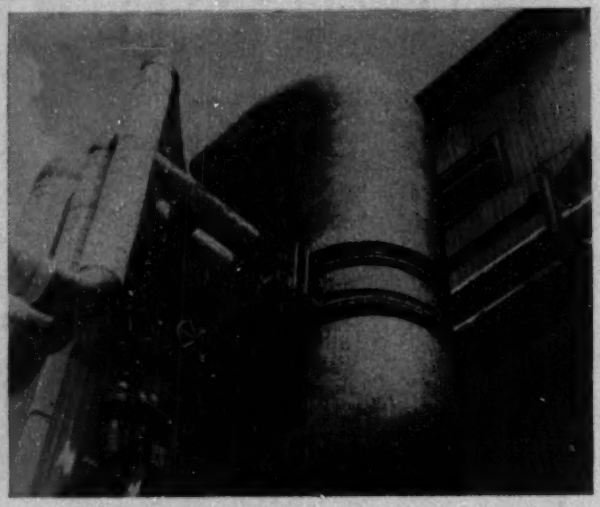
Write today for full information on the Hays Miniscale Gages Bulletin 52-1075-223.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
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CORPORATION
MICHIGAN CITY 9 INDIANA

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



R-S VALVES
OPERATE EASILY
Above or Below Floor Level

Because of their comparative light weight and minimum space requirements, R-S Valves are particularly well adapted for installation at considerable heights above the floor level. In such positions they are usually operated manually by chainlever, chainwheel, extended reach rod or controlled automatically.

Where the valve must be installed in an inaccessible position below the floor level, a floor stand is provided. Control is just as quick and uniform as in those installations where the handwheel is mounted directly on the valve shaft.

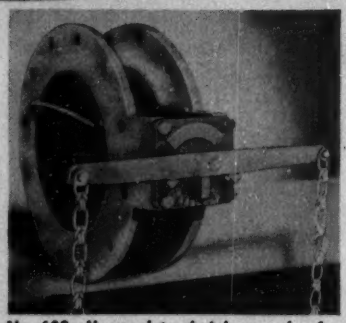
Simplicity of design, the wide range of application and ease of operation indicate the high order of metallurgical and mechanical engineering that is embodied in every R-S Valve.

Consult your local R-S Valve Engineers, or write direct.

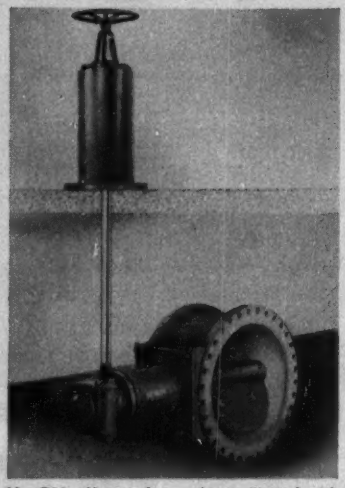
R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.

An S. Morgan Smith Company Subsidiary

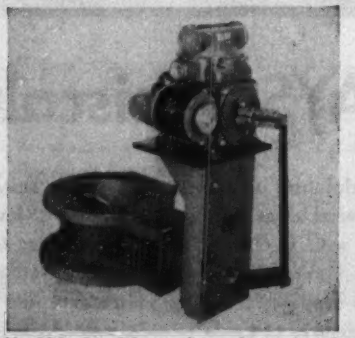
DISTRICT OFFICES IN PRINCIPAL CITIES



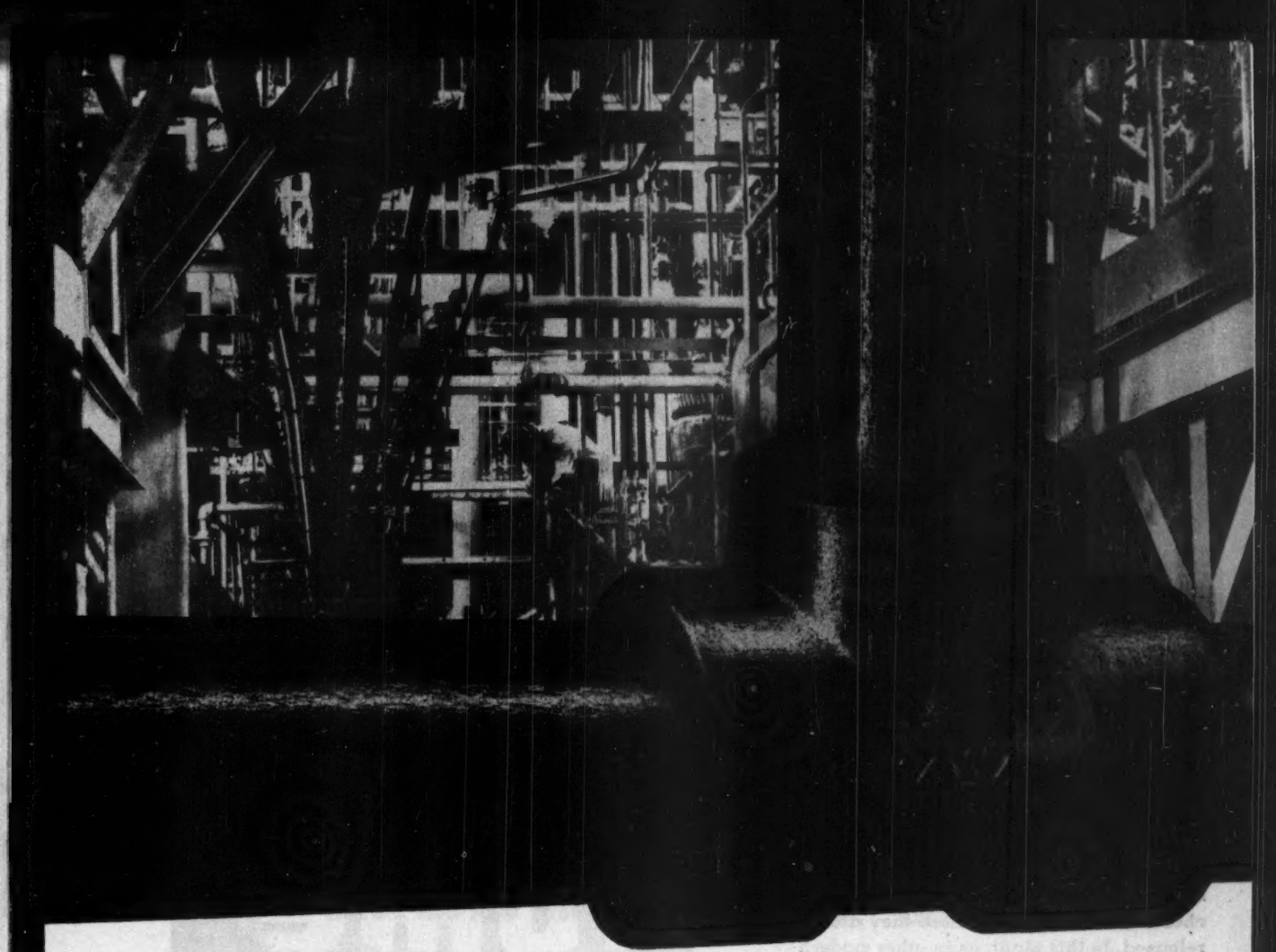
No. 688—Heavy duty chainlever valve for quick opening or closing in elevated and inaccessible locations. R-S Valves are used to control and shut-off the volume and pressure of nearly all materials in the temperature range from minus 300° to plus 2000° F. 2 to 2500 psig.



No. 788—Heavy duty valve equipped with rubber seat, totally enclosed gear reduction drive, extended shaft and floor stand. Positive shut-off is obtained up to 125 psig with rubber seated valves and commercially tight shut-off to even higher pressures with a babbitted seat.



No. 839—8-inch heavy duty valve equipped with 125-pound flanges, 18-8 shafts, bronze bushings and a throttling type motor operator for the control of low pressure air.



THEY'RE LOOKING DOWN YOUR PIPELINE...



Those twin scourges of industry—Lost Production and High Maintenance—are constantly drawing a bead on economical operation . . . looking down this nation's arteries for the lines of least resistance to heat, pressure and corrosion.

There *is* one way to spoil their aim: make sure that *your* pipe and tubing sections are joined with fittings of a kind that match them in chemical and physical properties, in strength and weight.

W-S Double-Diamond FORGED STEEL Fittings in both screw-end and socket-weld types give you all these qualities . . . provide life-of-the-line joints for any kind of make-up.

Literature is available . . . write for it.

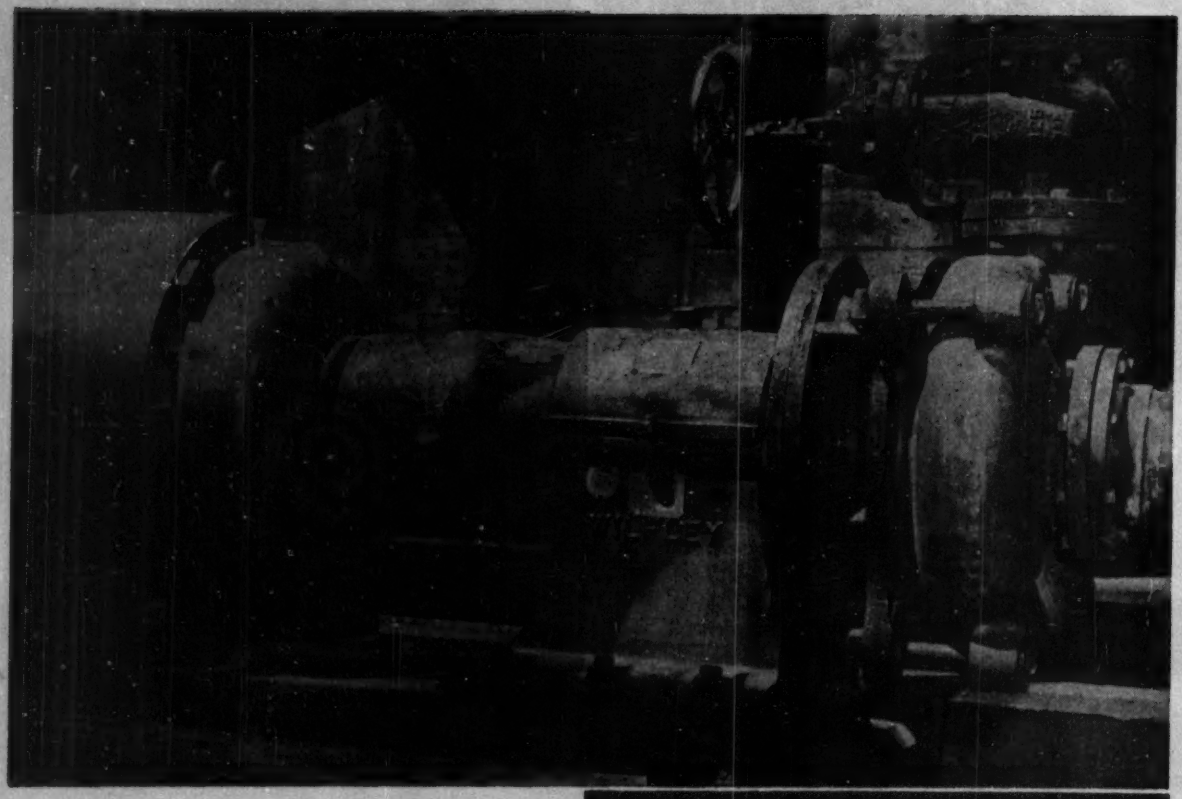
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The illustration above shows one of many possible WILFLEY applications...

Spray tower circulation removing harmful chemicals from gasses before they are released. In this plant, as in other modern plants all over the world, WILFLEY Acid Pumps are making impressive production records for low-cost handling of acids, corrosives, hot liquids and mild abrasives.

10- to 2,000-G.P.M. capacities; 15- to 150-ft. heads and higher. Wetted parts of all machinable alloys; plastic lined models available. Individual engineering on every application.

Write or wire for Bulletin E-7000, showing Model "AF" Acid Pumps in direct-drive, belt-drive and overhead belt-drive models.

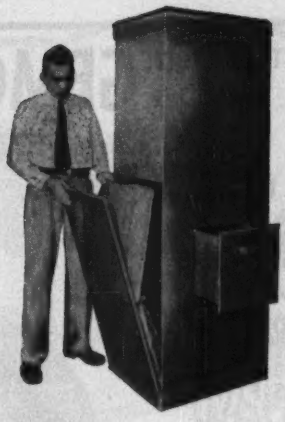
Buy WILFLEY for Cost-Saving Performance

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A. R. WILFLEY & SONS, Inc.
DENVER, COLORADO • U. S. A.
New York Office: 1775 Broadway, New York City

WILFLEY Acid PUMPS

Companion to the Famous WILFLEY Sand Pump



. . . Type "M"

Three models . . . 450, 900 and 1800 CFM capacity . . . cleaned air can be vented to outside or returned to room.

dust problem?

here's the low cost solution . . .

KIRK AND BLUM unit dust collectors

Where one or several dust-producing machines are operated without a dust collecting system or are too remote from the existing collection system, here's the efficient, trouble-free and low-cost solution. KIRK & BLUM Unit Dust Collectors are compact, easy to install or move, offer exceptional efficiency and capacity.

Both types have many features not found in conventional units, employing rugged material-handling fans and motors from ¼ to 3 H.P. They are specifically designed for trouble-free operation, easy cleaning and complete dependability.

For complete details, request literature on metal or woodworking types from The KIRK & BLUM MFG. CO., 3208 Forrer Street, Cincinnati 9, Ohio.

. . . Type "W"

Single model . . . 900 CFM capacity . . . ample for one 6", two 4" or four 3" pipe connections.



FOR CLEAN AIR . . . THE INVISIBLE TOOL

KIRK AND BLUM

DUST CONTROL

COVER THE EARTH

Lilly

SHERWIN-WILLIAMS

Celanese

CORPORATION OF AMERICA

SINCLAIR

GOLD SEAL



ALL THESE FIRMS CHOSE The Cowles DISSOLVER

. . . because it dissolves and disperses 2 to 20 times faster — and in the same space ordinary mixers require! The secret: the Cowles impeller which operates at velocities up to 7,500 f.p.m.

The Cowles Dissolver saves not only time and labor, it improves your product and yield per batch as well. It's rugged, fast-loading, easy to maintain, performs tasks other mixers cannot.

GET THE FACTS . . . on the Cowles Dissolver — send for a catalog today! And ask to have a detailed test run on your materials.

The Cowles Company INCORPORATED

THE COWLES COMPANY, INC.
112 Trackside, Cayuga, N.Y.

Gentlemen: Please send me your latest Cowles Dissolver catalog.

NAME

COMPANY

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CITY AND STATE

Pocketsize Performance*



*22 in. x 25½ in.

. . . with big equipment accuracy . . . that's Sutton's new

***Whippet* V-80**

Specific Gravity Separator designed especially for small lot operations!

Now for the first time in separating equipment history here is a portable lab-size separator, incorporating all the inherent performance qualities of standard size machines. Now for the first time you can *economically* assay products for accurate "commercial yield" data *before* setting up full-scale processing operations.

There's a lot you'd like to know about Sutton's new *Whippet V-80*. There's a lot we'd like to tell you.

Write Dept. C353

SUTTON, STEELE & STEELE, INC.

1031 SOUTH HASKELL • DALLAS, TEXAS

SALES AND SERVICE: DALLAS • COLUMBUS, GA • NEW YORK • PITTSBURGH • CHICAGO MINNEAPOLIS • CLEVELAND • DES MOINES • SAN FRANCISCO • TWIN FALLS, IDAHO FOREIGN: WINNIPEG, CANADA • SAO PAULO, BRAZIL • LONDON, ENGLAND

SUTTON STEELE & STEELE INC

STANDARDIZE WITH GEMCO SPHERICAL DUST-TIGHT VALVES

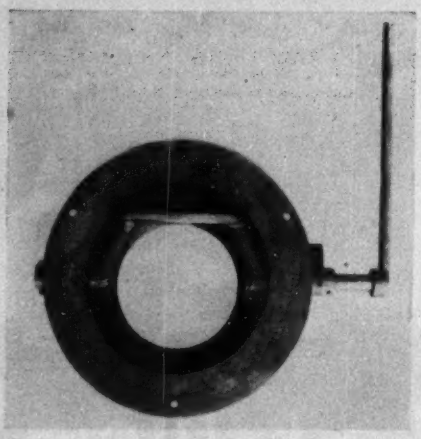
FOR BINS, HOPPERS, BLENDERS, PIPE LINES

NO STICKING

NO DUSTING

NO SIFTING

HAND, AIR OR MOTOR OPERATED



GEMCO VALVES give you unfailing control of DRY POWDERS, eliminate spillage, sifting, clogging in the handling of DRY POWDERS, fine or coarse, hot or cold.

GEMCO VALVES can be made to suit your condition. Let us show you how this FREE-FLOWING valve can solve your problem.

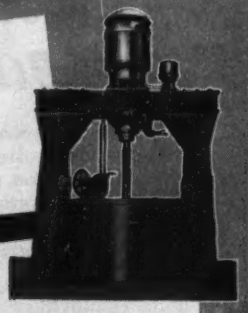
Here is a valve for dry materials that cleans its own disc and seat, every time it swings open and shut. Both seat and disc are curved to a mating fit. Report on the first one installed is 500,000 open and shut operations without a bit of trouble from the corrosive powder it carries.

The valve opens freely to a full opening and there is nothing to obstruct the full flow of material or to cause bridging. The valve is made of hard, non-galling, abrasive, and corrosive-resisting materials.

GENERAL MACHINE COMPANY OF NEW JERSEY

400 MARKET STREET **NEWARK 5, NEW JERSEY**

SPEED
at every step of operation

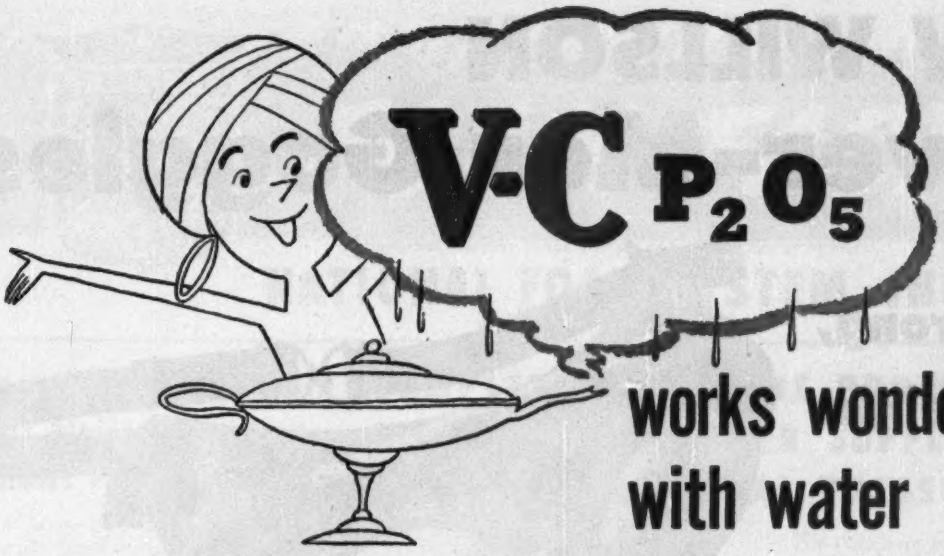


the key to High Production of FLETCHER CENTRIFUGALS

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works wonders with water

Whether you are manufacturing cleansers or water softeners, processing textiles or cheese, dispersing clay or treating boiler water, it will pay you to investigate the advantages of V-C Sodium Phosphates. Their water-softening ability, emulsification and dispersion properties and free-rinsing quality over a wide range of uses are outstanding. Examine the individual characteristics of each V-C Sodium Phosphate, outlined below, then write for full details.

V-C DSP (Disodium Phosphate) Anhydrous

Specifications: Minimum P_2O_5 content is 48.0%; less than 2% moisture. The pH of a 1% DSP solution is 9.0.

Physical Properties: Small white flakes, readily soluble giving a clear solution.

Characteristics: Mild alkalinity, emulsifies fats and oils, "deflocculates" or suspends solids, is a good buffer.

Advantages: Anhydrous DSP contains no water of crystallization as does the duohydrate DSP or crystalline (12 H_2O) DSP. Very economical, less alkaline than TSP, excellent water softener.

Uses: Boiler water treatment to control caustic embrittlement, textile cleaning, manual cleansers, plasticizer in the manufacture of processed cheese, and many other uses.

V-C TSP (Trisodium Phosphate)

Specifications: Surpasses requirements of Federal Specification O-T-671a and ASTM Specification D538-44. P_2O_5 content is 18.5%. The pH of a 1% TSP solution is 11.8.

Physical Properties: Easily soluble white crystals.

Characteristics: Readily emulsifies fats and oils, softens water, "deflocculates" or suspends solids, rinses clear.

Advantages: Has higher alkalinity than DSP or polyphosphates. Good water softener. Economical.

Uses: For manufacture of cleansers, cleaning compounds, soaps and water softeners. Also for metal cleaning, boiler water treatment, textile processing, and other uses.

V-C STPP (Sodium Tripolyphosphate) Anhydrous

Specifications: Minimum P_2O_5 content is 57%; less than 1% moisture; calcium value, 10. The pH of a 1% STPP solution is 9.8.

Physical Properties: Anhydrous white powder (finer than 20-mesh), soluble in water.

Characteristics: Mild alkalinity, good sequestering agent, very effective peptizing agent, fairly stable.

Advantages: Greater sequestering power than TSPP. Cheaper than organic sequestrants. More stable than other polyphosphates except TSPP.

Uses: Builder for synthetic detergents and soaps, boiler feedwater treatment, industrial cleansers, textile processing, paper manufacturing, clay dispersing and many other uses.

V-C TSPP (Tetrasodium Pyrophosphate) Anhydrous

Specifications: Minimum P_2O_5 content is 53%; less than 1% moisture; 98.0% $Na_4P_2O_7$. The pH of a 1% solution is 10.2.

Physical Properties: Anhydrous white powder (finer than 20-mesh), soluble in water.

Characteristics: Exceptional water softening ability, high emulsification and dispersion properties, mild alkalinity, good buffering and rinsing properties, very stable.

Advantages: More stable than other polyphosphates. More economical than organic sequestrants and other polyphosphates.

Uses: Builder for synthetic detergents and soaps, mud treatment, water treatment, textile processing, industrial cleansers, cheese manufacture, cold water paints and other uses.

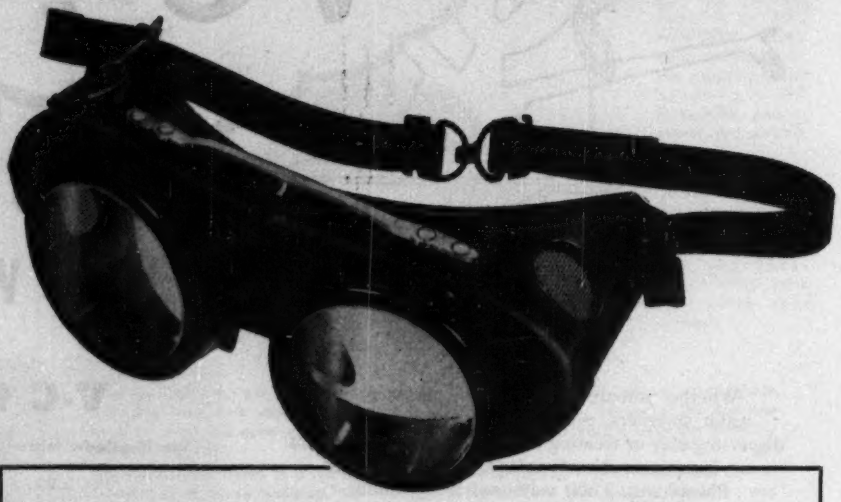
Elemental Phosphorus
Phosphoric Acids
Trisodium Phosphate
Disodium Phosphate-Anhydrous
Tetrasodium Pyrophosphate
Sodium Tripolyphosphate
Ferrophosphorus
Sodium Metasilicate
Tetraethyl Pyrophosphate
Alkyl Phosphites
Other Organic Compounds of Phosphorus

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with strong, lightweight nylon eye cups





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FOAM FACTS

Published quarterly in the interests of fire protection everywhere.

NATIONAL FOAM SYSTEM, INC.

WEST CHESTER, PENNA.

Portable Foam House Cuts Maintenance Costs, Allows Plant Expansion

A large Southern refinery was recently faced with the need of eliminating the excessive cost of maintaining its main line chemical foam piping system. Also, a more flexible system was wanted, to allow for future expansion.

Portable System Devised

To solve this problem, engineers of National Foam System designed and installed a completely portable "Foam House on Wheels," consisting of two trucks and a trailer. Each truck was equipped with an Aer-O-Foam Liquid Proportioning Pump, a 900-gallon tank for Aer-O-Foam Liquid 3% Regular, nozzles and hose. One truck was equipped with a water pump, the other designed so that a water pump could be added later if desired. The trailer housed a gasoline-driven pump and hose.

Costly Piping Eliminated

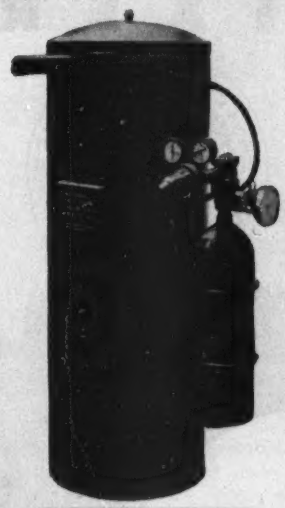
Foam house and main line piping were abandoned, and only the lateral piping to foam chambers was retained. All existing chemical foam chambers were converted with the new National MCV foam makers for use with mechanical Aer-O-Foam.

Complete Flexibility

When fire occurs, a truck or trailer is spotted at a point near a water hydrant, the hose is connected and, when water is flowing through the truck, the Aer-O-Foam Liquid Proportioner is adjusted to inject foam liquid at the proper rate. Two flow meters provide a continuous check on the accuracy of the water and Liquid input. When tanks are not equipped with chambers, foam towers are similarly used.

The result is better, more flexible protection, elimination of the costly piping system and foam house, and adaptability to the expansion plans of the refinery.

COMPLETE FOAM FIRE PROTECTION... NO WATER OR POWER SUPPLY NEEDED WITH NEW NATIONAL PRESSURE-PACK



For complete foam fire protection where neither water nor power is available, the new National Pressure-Pack is the ideal answer. Here is a completely self-contained, pressurized, mechanical foam unit, supplied in four standard sizes ranging from 33- to 200-gallon solution capacity. The largest unit can produce 2,000 gallons of fire-smothering Aer-O-Foam in less than three minutes.

The Pressure-Pack is designed for use with overhead spray deflectors, dip tank or drainboard deflectors, floor nozzles or portable nozzles. Installations may be either portable or fixed. Operating pressure is supplied by a nitrogen or air cylinder.

A control for local manual operation is provided. Other available controls include remote manual operation, completely automatic operation, or any combination of these controls. The unit is easy to install and maintain, can be tested at any time without using Aer-O-Foam Liquid, and can be recharged in a matter of minutes after use.

For all isolated hazards, or wherever water and power are not available, the Pressure-Pack supplies the same dependable Aer-O-Foam that is so widely used by the largest refineries and bulk plants. A complete descriptive folder is yours for the asking.

150 Years of Skill

Although National Foam System, Inc., marks the Silver Anniversary of its incorporation this year, its experience goes back almost 150 years, through the days when its predecessor, James Boyd & Bro., was later one of the largest manufacturers of motorized fire-fighting apparatus.

In the late 1920s, National Foam developed the first dual-line dry powder chemical foam system used in this country. In World War II, National helped to save innumerable lives and ships through its development of Aer-O-Foam, the mechanical foam known as "Navy Bean Soup." Again, National helped design equipment for loading jelly gasoline fire bombs.

Today National Foam System still serves the Armed Forces while it expands to meet the growing needs of industry. New products, improved designs, greater variety are combined in National Foam's largest and most versatile line of foam and foam equipment to be found anywhere.

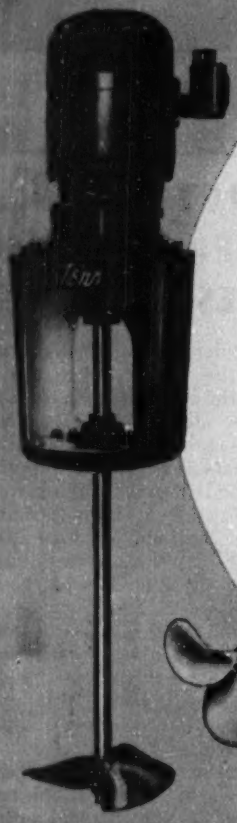
Send for Your Free FOAM FACTS Subscription

FOAM FACTS, a quarterly magazine packed with interesting information on foam fire-fighting, will be mailed to you entirely free upon request. Just send your name and address to National Foam System, Inc., West Chester, Pa. There's no obligation, of course.

Fluid Mixing

with

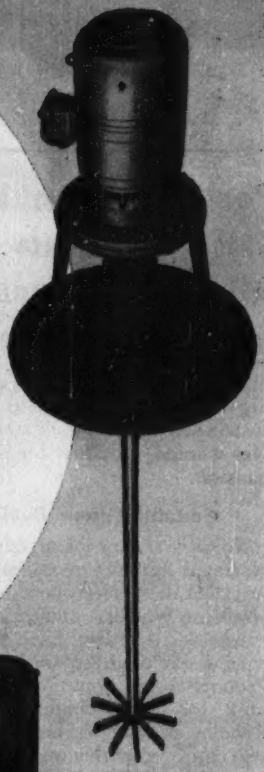
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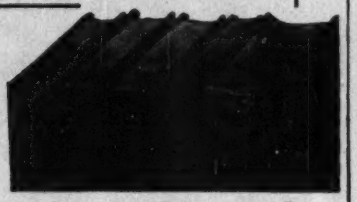




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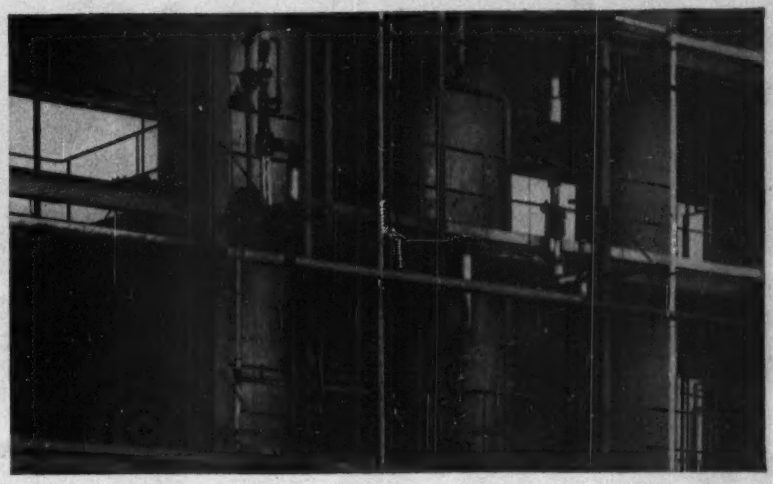
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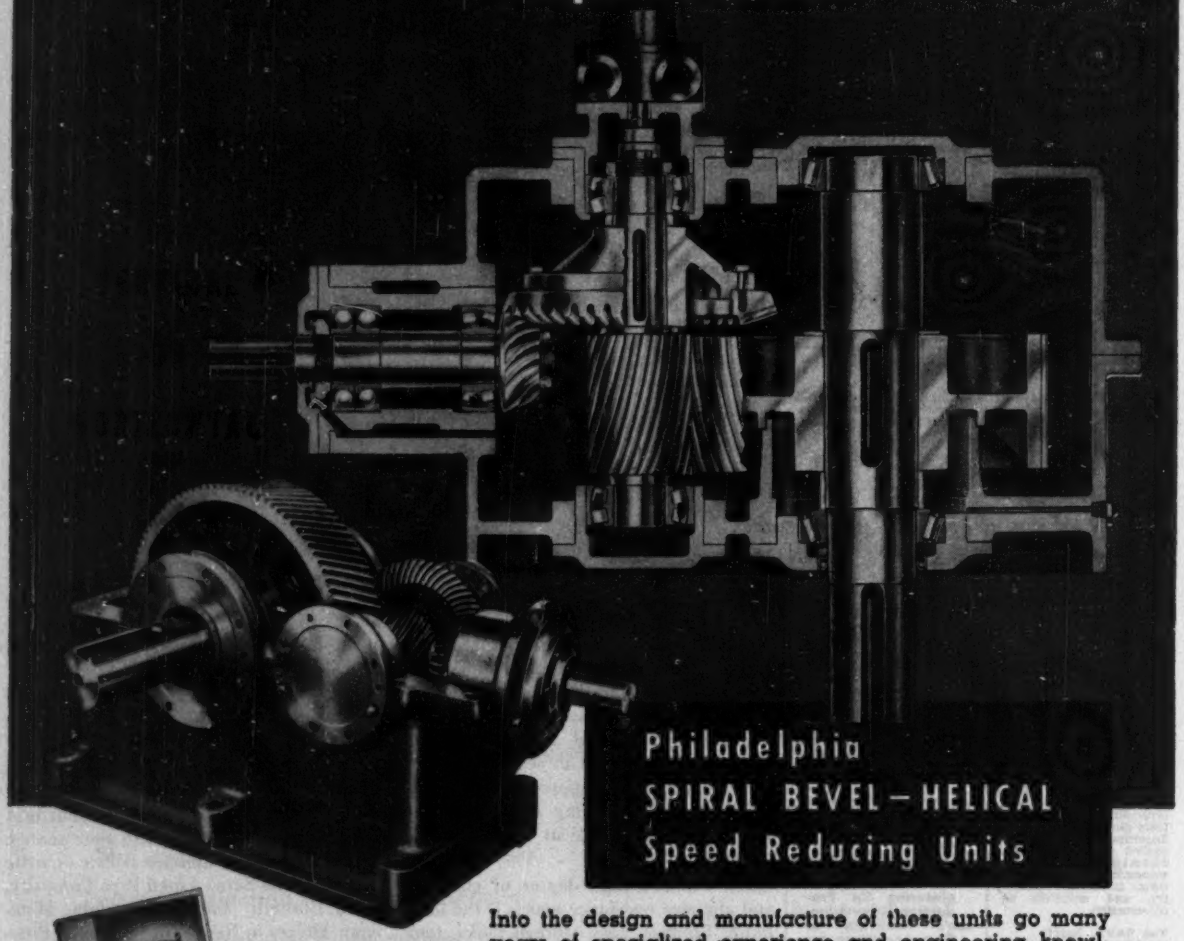
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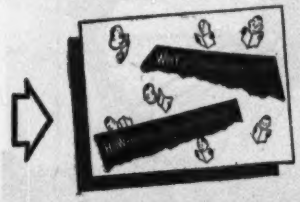
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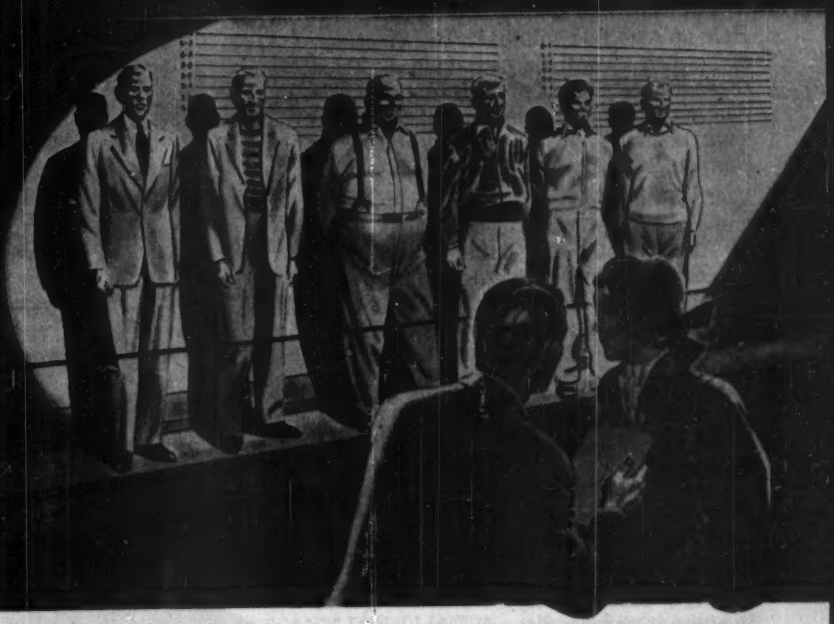


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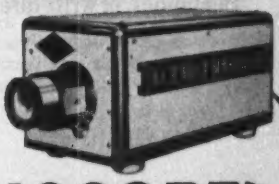
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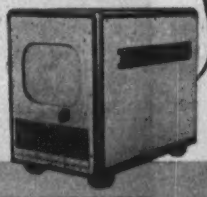


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In many industrial processes, there also is no substitute for a good look. Correct control depends upon the operator having a SENSE OF REALISM that instruments cannot provide . . . that SEEING alone can give.

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You will find modern equipment and machines, many of them designed and built by Alco, capable of meeting almost every conceivable type of metal-fabricating requirement—facilities operated by skilled craftsmen, and applied by designers and engineers fully aware of industry's needs.

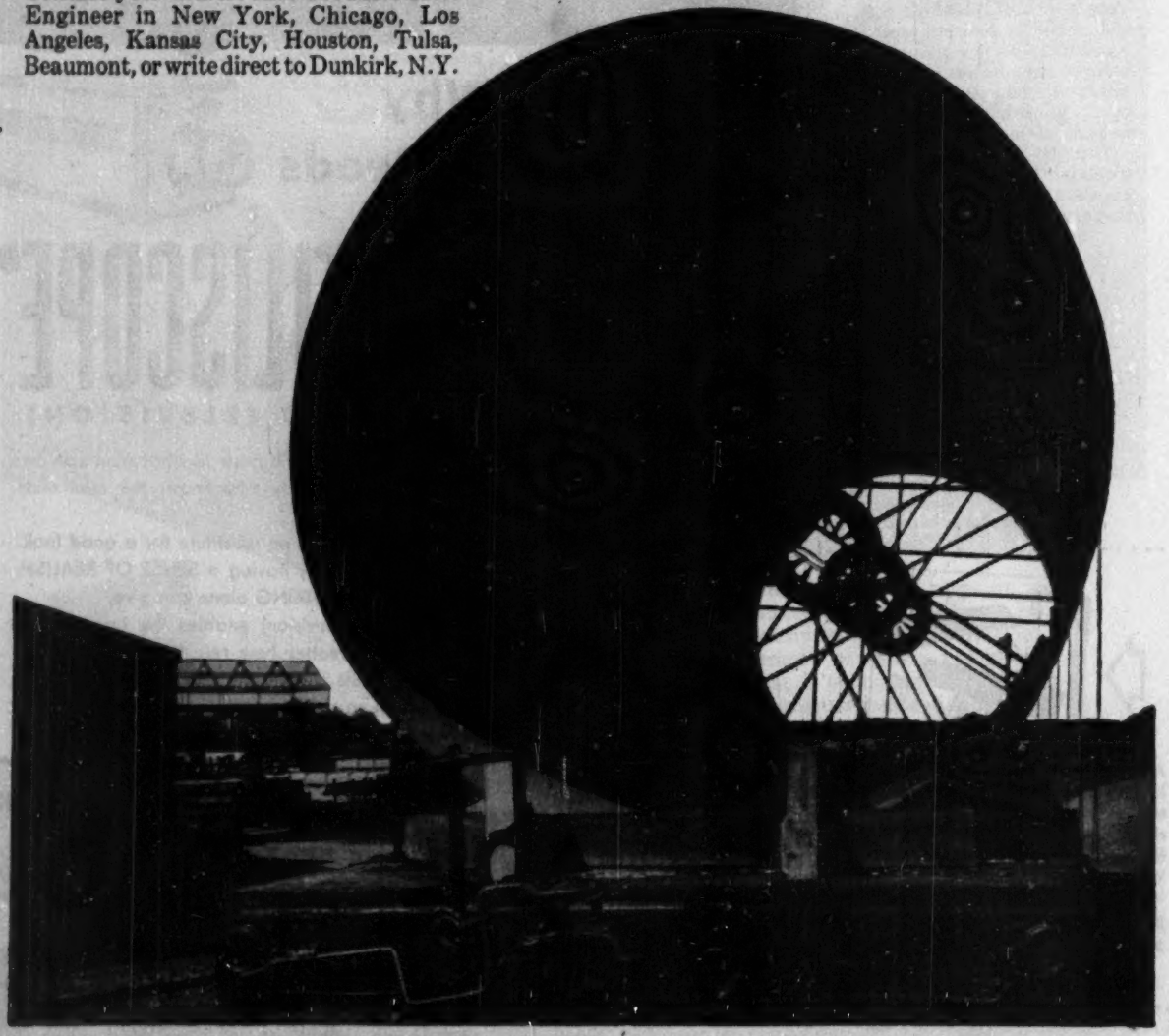
If you have a difficult metal-fabricating problem—a problem that challenges the imagination, that points to new equipment or offers new opportunities to cut production costs—we invite you to let Alco's facilities and experience produce the answer.

Contact your nearest Alco Products Sales Engineer in New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, Beaumont, or write direct to Dunkirk, N.Y.

ALCO facilities

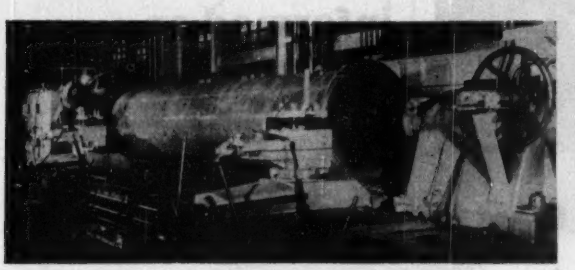
Answers to

TUNNEL INTERLININGS furnished by Alco in cold-rolled, carbon-silicon steel sections 40 ft long and 10 ft 6 in. in diameter will reinforce the outlet end of New York City's new $44,000,000 deep-rock East Delaware Water Supply Tunnel. Held to close dimensional limits, electric fusion welded throughout, they are the latest of many special piping sections fabricated over the years by Alco for New York water supply projects.

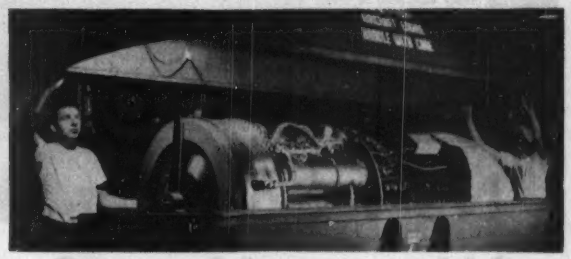


and experience produce...

New Industrial Problems



GIANT LATHE at Alco's 31-acre Dunkirk plant finishes and faces both flanges simultaneously on steel pipe up to 41 in. in diameter! Special machines like this, many of them Alco designed and all guided by the skilled hands of veteran craftsmen, help Alco solve the toughest of metal-fabricating problems.



STEEL "CANS" FOR JET ENGINES, mass-produced by Alco, are carefully engineered to meet strict Air Force specifications. Example: they must "provide a barrier against the entry of water, dust, air and moisture *without* the aid of separately applied sealing compounds or materials."

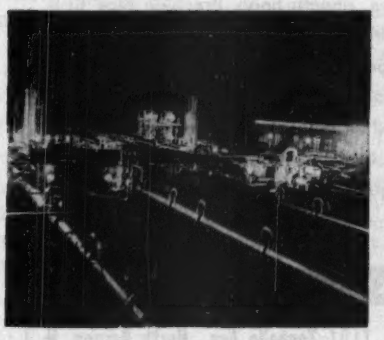
ALCO

ALCO PRODUCTS DIVISION

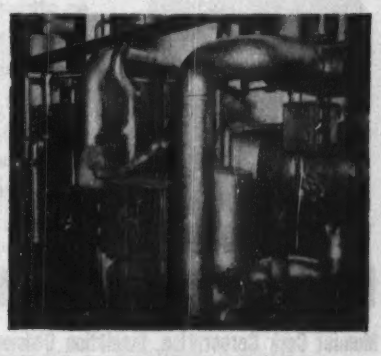
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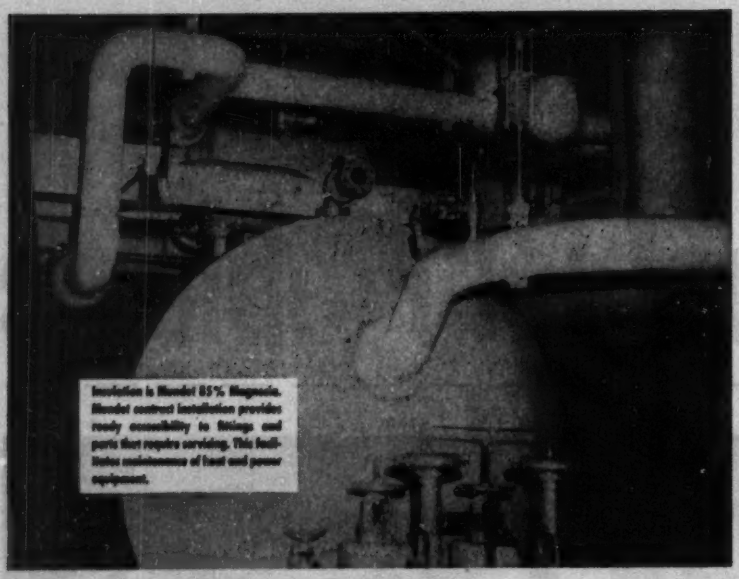
"UNI-BUNDLE UNITS," with their specially fabricated steel headers, demonstrate the versatility of Alco Aircoolers. Vertical partitions welded in the headers allow several different vapor or liquid streams to be handled in a single tube-bundle. Here, for example, at a large Southwestern natural gasoline plant, the Alco Aircooler at right not only cools the oil but also condenses the overhead vapor from the stream.



"TRAIN" HEAT EXCHANGERS, designed and built of nickel steel by Alco for the Tennessee Gas Transmission Company's new gas processing plant (the world's largest) at Gabe, Kentucky, helped cut both installation and operating costs. Their flange-to-flange construction minimized the amount of connecting piping required, while their huge size (42 in. in diameter, 150 ft long) assured maximum processing efficiency.



SPECIAL ALCO FLEX-TUBE EVAPORATORS at the Carolina Power and Light Company's new 150,000-kw plant at Goldsboro, N. C., produce vapor containing not more than 0.5 parts per million of mineral solids, hold make-up to less than one-half of one per cent. With its patented Flex-Tube construction, this Alco evaporator offers industry a positive-acting thermo-mechanical descaling device for straight-tube installation.



New Booklet Shows Way to Heat Savings *with* Mundet "Custom Molded" 85% Magnesia Insulation

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CHARLOTTE 6, N. C.
2201 N. Davidson St.

CHICAGO
35 E. Wacker Drive

CINCINNATI
427 West 4th St.

DALLAS 10
601 Second Ave.

DETROIT 11
14401 Prairie Ave.

HOUSTON 1
Commerce and Palmer Sts.

INDIANAPOLIS 4
50 E. Martill St.

JACKSONVILLE 6, FLA.
800 E. Bay St.

KANSAS CITY 7, MO.
1210 W. Ninth St.

KNOXVILLE 16
1221 Grand Ave.

LOS ANGELES
(Maywood): 6116 Walker Ave.

IN CANADA:
Mundet Cork & Insulation, Ltd., 85 Booth Ave., Toronto

NEW ORLEANS 16
315-25 N. Front St.

NEW YORK 17
521 Madison Ave.

PHILADELPHIA 39
856 N. 48th St.

ST. LOUIS 9
3170 Brannon Ave.

SAN FRANCISCO 7
440 Brannan St.

WASHINGTON, D. C.
600 F Street, N.W.



How to keep informed on the "with what" part of your business

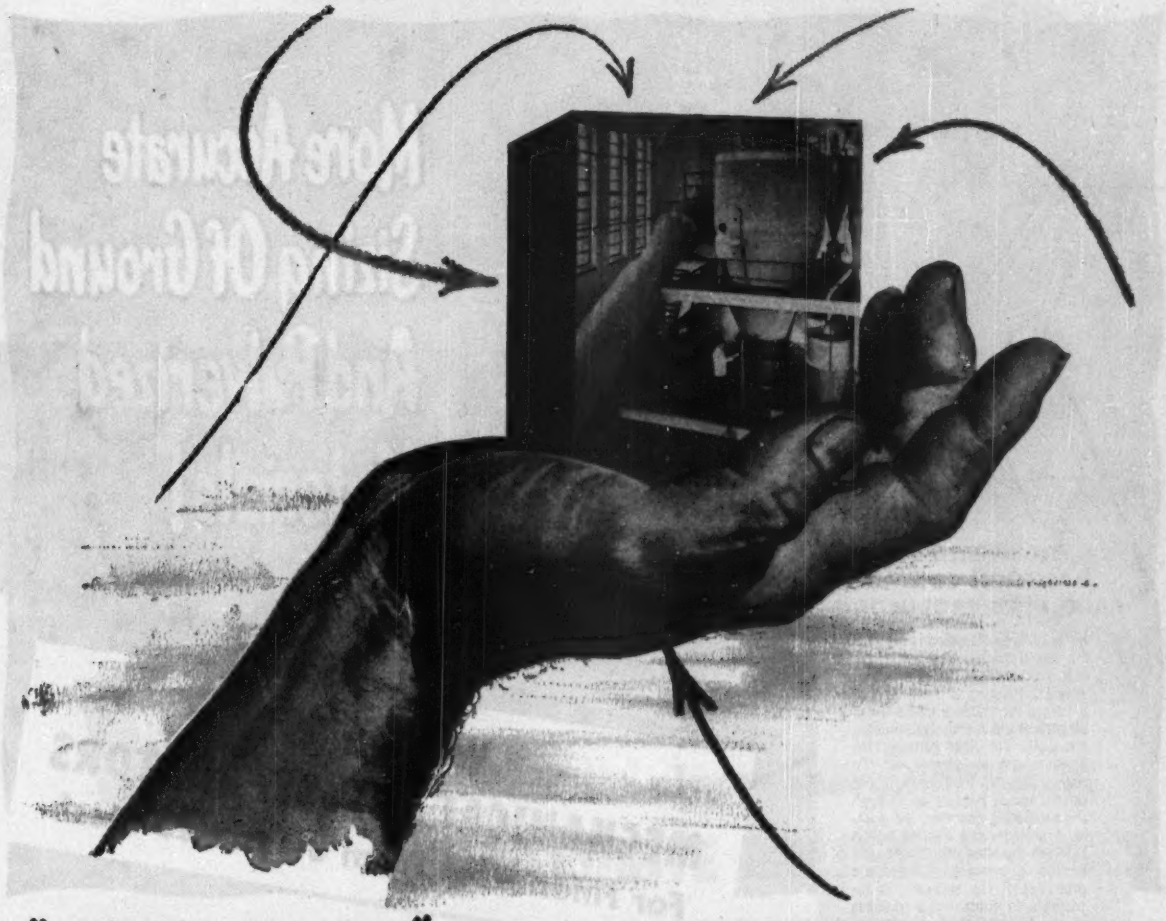
AT YOUR FINGER TIPS, issue after issue, is one of your richest veins of job information—advertising. You might call it the "with what" type—which dovetails the "how" of the editorial pages. Easy to read, talking your language, geared specifically to the betterment of your business, this is the kind of practical data which may well help you do a job quicker, better—save your company money.

Each advertiser is obviously doing his level best to give you helpful information. By showing, through the advertising pages, how his product or service can benefit *you* and *your* company, he is taking *his* most efficient way toward a sale.

Add up all the advertisers and you've got a gold mine of current, on-the-job information. Yours for the reading are a wealth of data and facts on the very latest in products, services, tools . . . product developments, materials, processes, methods.

You, too, have a big stake in the advertising pages. Read them regularly, carefully to keep job-informed on the "with what" part of your business.

McGRAW-HILL PUBLICATIONS



"Million Dollar" Magic For Your Product!

Can spray drying give your product a new form, more markets, or a big boost in profit potentials? Does your product have a chance to share in these exciting new advancements? The answer could be yes! Swenson spray drying research has helped many leading companies climb to new sales records. The list includes such fast moving money makers as instant coffee, plastic powders, paper coating materials, antibiotic fermentation residues, and petroleum catalysts.

Next could be your own product! The quickest way to find out is to test it in the Swenson *full-size* spray dryer. You'll get the facts . . . and you'll get the benefit of experienced analysis and engineering by the leader in spray drying advancements. Talk spray drying with Swenson today!

PRODUCTION BASIS TESTING FOR FACTS: NOT GUESSWORK!

The Swenson Research Laboratory Spray Dryer is commercial-size . . . the results you get from experimental tests, in barrel or carload lots, will match those of actual production conditions. You'll know the facts before major investment is required!

ENGINEERING THAT HELPS YOU PLAN FOR PROFITS!

Get the benefit of Swenson's combined experience in hundreds of successful spray drying applications! Swenson representatives are engineers equipped to help you in every phase of the spray drying problem . . . analysis, layout, design and manufacture of equipment and initial supervision of the job!

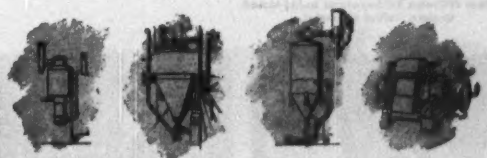
SWENSON EVAPORATOR COMPANY
15669 Lathrop Avenue • Harvey, Illinois

SWENSON

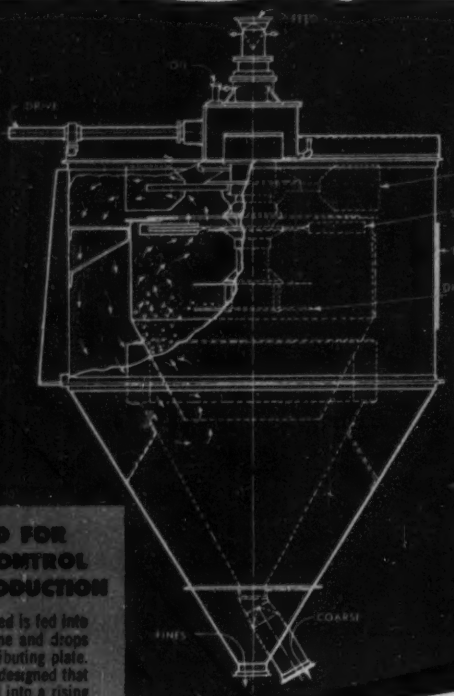
Proved Engineering for the Process Industries

SINCE 1889

A Division of WHITING Corporation



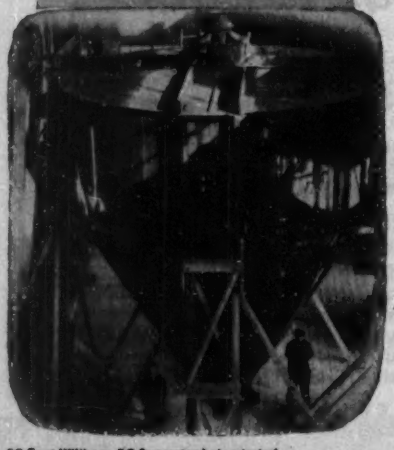
Evaporators Spray Dryers Crystallizers Filters



More Accurate Sizing Of Ground And Pulverized Materials!

ENGINEERED FOR PRECISION CONTROL AND HIGH PRODUCTION

Material to be classified is fed into the top of the machine and drops onto a revolving distributing plate. This distributor is so designed that it sprays the material into a rising air current which entirely surrounds the plate. The finer particles are lifted by the air stream and the coarse particles drop down to the rejects spout. Passing up through the separating chamber, the dust-laden air is given a whirling motion between Spinner blades and any remaining oversize particles are precipitated. The separator is adjustable to control the fineness of the finished product with unusual accuracy.



18-Foot Williams RC Separator being tested at plant before shipment.

WILLIAMS MECHANICAL AIR SEPARATORS

For Finenesses From 30 to 325 Mesh

- Most efficient mechanical air separator ever developed for classifying ground and pulverized materials, or for removing fines from dry ground materials before classifying.
- Product quality is vastly improved and output considerably increased when operated in closed circuit with virtually any type of mill.
- Will handle with equal efficiency a complete range of products—mineral, chemical and vegetable—from the hardest, most dense limestone and ore to the softest, fluffiest starches and flours.
- Permits coarser settings in grinding equipment thus lengthening equipment life by reducing wear on all moving parts. Power consumption is much lower.
- Extra heavy construction. Equipped with anti-friction bearings encased in dust-proof and moisture-proof housings. All casings are of heavy steel plate construction. Operation is dustless and repair cost is practically nil, since there are no fine sieves to wear out and the heavy construction insures long life.

9 Standard sizes, 2½ to 18-foot diameters — Capacities from 500 lbs. to 75 tons hourly

Write For Details And Describe Your Operation

WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 NORTH NINTH • ST. LOUIS 6, MO.

WILLIAMS

CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



. . . another place where REPUBLIC

ELECTRUNITE PRESSURE TUBES

DO THE JOB BEST . . .

When you take heat exchangers off-stream for retubing, make sure you increase the time between retubings . . . install Republic ELECTRUNITE Pressure Tubes.

You have your choice of carbon steel tubes and several analyses of ENDURO Stainless Steel tubes . . . all made by the ELECTRUNITE process which assures uniformly round tubes inside and out, uniform wall thicknesses and uniform bending and expanding characteristics.

And you needn't wait until retubing to get the long-lasting benefits of Republic ELECTRUNITE Tubes . . . leading manufacturers of heat exchanger equipment know and use these time-proven tubes for many *new* condensers and heat exchangers.



Write for Booklet giving specifications and design data on Republic ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
219 EAST 131st STREET • CLEVELAND 8, OHIO

ELECTRUNITE—The Original Electric Welded Boiler Tube

REPUBLIC STEEL

Republic ELECTRUNITE



Double Assurance

WHEN YOU SPECIFY

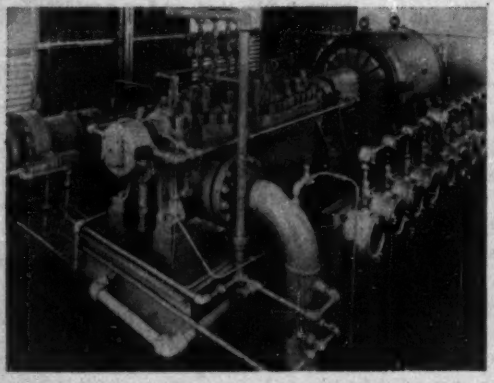
Pacific PRECISION BUILT PUMPS

The requirements for your specific service having been made known by your engineering specifications you will look carefully into the benefits offered by the various bidders. After looking, it's dollars to doughnuts your requisition will specify *"Pumps by Pacific"* because of the greater benefits of Pacific's *double assurance.*

Assurance that Pacific's design, workmanship and materials will fit the requirements of your specific service.

Assurance that Pacific's dependable fast service will fit your needs.

Designs to fit your specific service:



Pacific Pump Operated by Microwave—Unattended



TOP SUCTION—TOP DISCHARGE

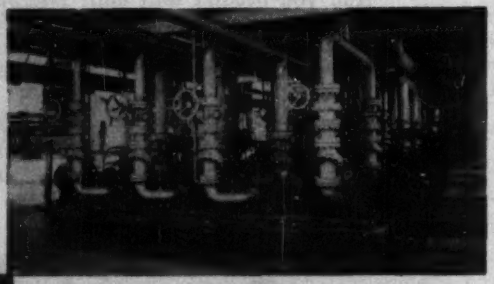


END SUCTION—TOP DISCHARGE



END SUCTION—SPECIAL DISCHARGE

Materials to fit your specific service:



Pacific Pumps for Special Service

CAST IRON
ALLOY IRON
BRONZE
CARBON STEEL
ALLOY STEELS including
HIGH NICKEL-CHROME
MOLOY STEELS

PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York

Offices in All Principal Cities



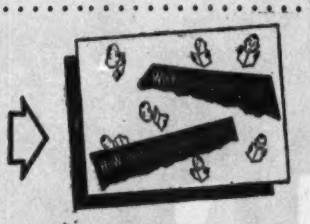
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This profit-wise peddler looks for the wettest crowds. His business is *specialized*. Like yours.

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McGRAW-HILL PUBLISHING COMPANY
330 W. 42nd St., New York 36, N. Y.

One of a series of ads prepared by
THE ASSOCIATED BUSINESS PUBLICATIONS

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ORLON*
(acrylic fiber)

Good resistance to hot mineral acids, weak alkalies, common solvents, oils, greases, neutral salts, acid salts and chlorine.

• • •

No loss of strength after 32 days exposure to air at 257°F. Negligible shrinkage.

VINYON N**

Excellent resistance to strong acids such as sulphuric, nitric, hydrochloric, hydrofluoric and aqua regia. Also to sodium and potassium hydroxide; chlorine and bromine water, silver nitrate, tannic acid and many oils, fats and waxes.

Boiling solutions are readily withstood by these versatile media.

SARAN

Exceptional resistance to acids, particularly hydrochloric, and to alkalies except ammonium hydroxide. Unaffected by alcohols or aliphatic hydrocarbons. Continuous exposure up to 160°F. and intermittent exposure up to 212°F. do not appreciably affect tensile strength.

GLASS

Woven from highly resistant, durable chemical glass. Usable where such synthetic itself is usable.

*T.M.—E. I. DuPont de Nemours Co.
**T.M.—Union Carbide & Chemical Co.

These cloths are available in several weaves and in standard widths ranging from 26" through 72" or made up into filter element covers. These cloths are all woven in our own mill by operators having long experience in the art of synthetic fabric weaving.

Weavers of Industrial Filter Media for over Forty Years

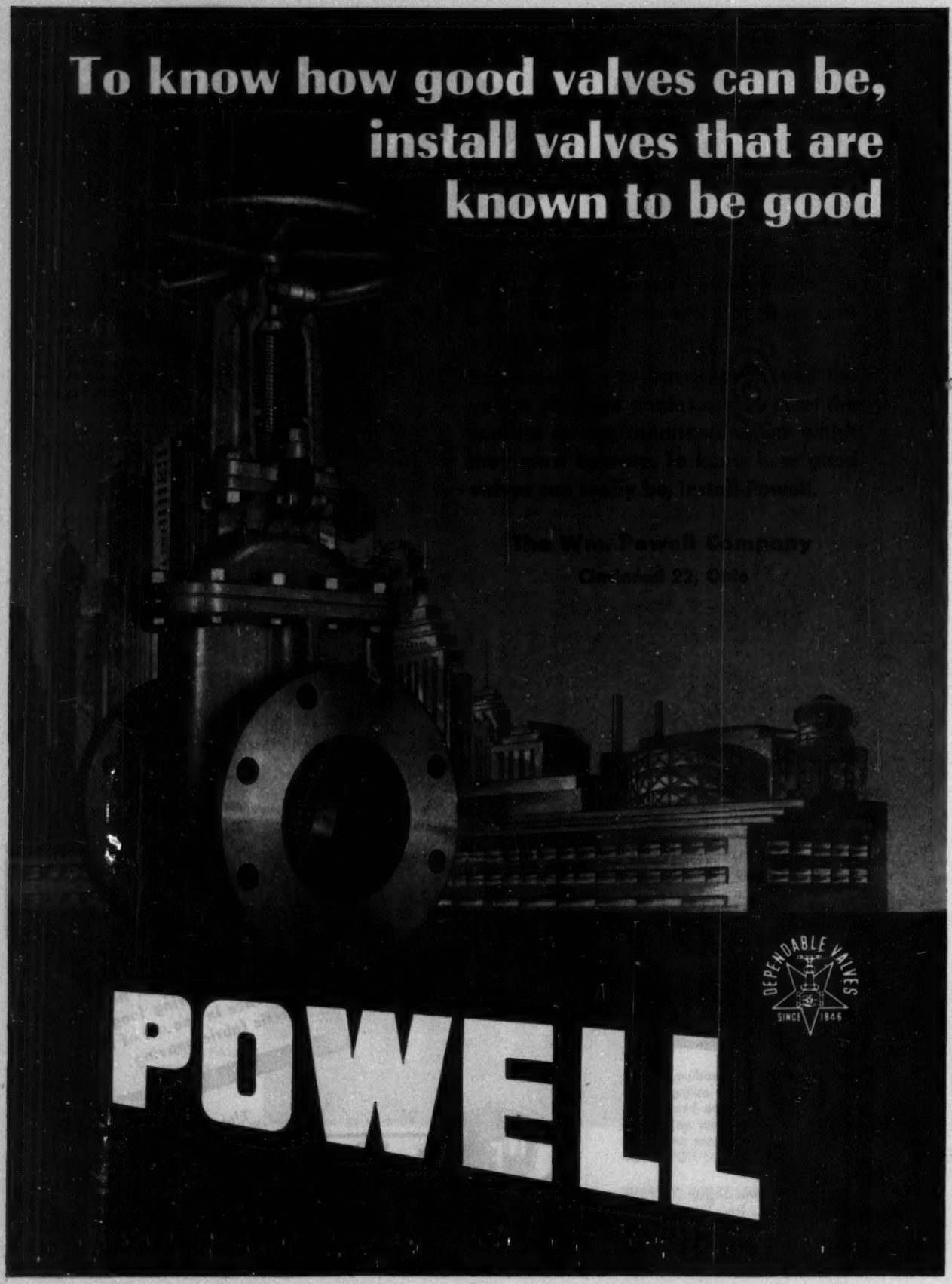
The National Filter Media Corp.

General Offices & Mills: New Haven 14, Conn.
Western Office & Factory: Salt Lake City 1, Utah

Sales Offices—Representatives

Chicago, Ill. 2627 West 19th St. | Cincinnati, Ohio Boulevard Center Bldg. | Houston, Texas 1406 Second National Bank Bldg. | Oslo, Norway Nicolai Friis | Johannesburg, South Africa Edward L. Bateman

To know how good valves can be, install valves that are known to be good



DEPENDABLE VALVES SINCE 1846

POWELL

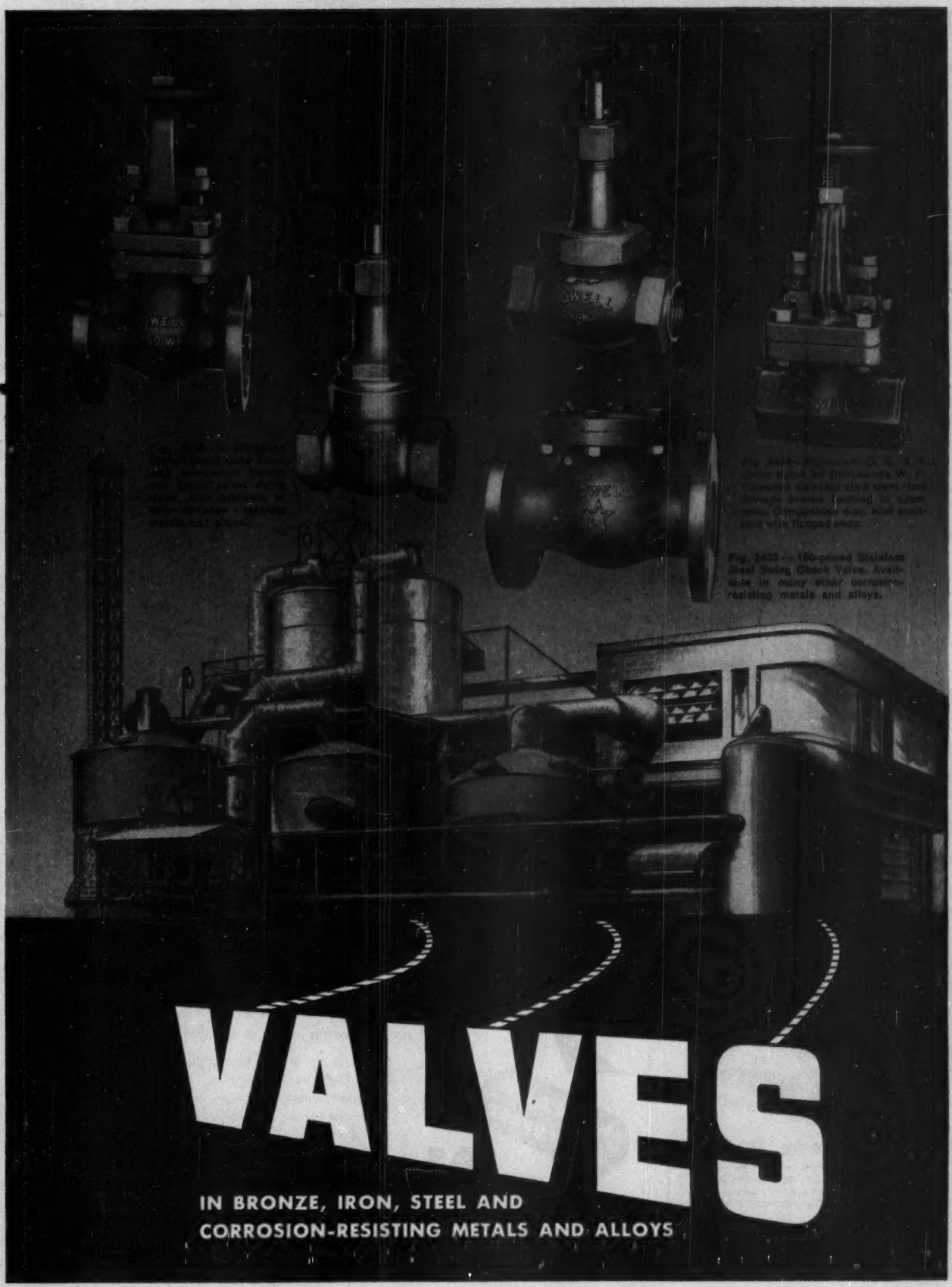


Fig. 3433—150-pound Stainless Steel Swing Check Valve. Available in many other corrosion-resisting metals and alloys.

FILTER FABRICS

OVER 40 DIFFERENT WEAVES

Cotton, Wool, Synthetic, and Woven Glass Cloths for all purposes. Cloths punched and sewed to required size.

VINYON
ORLON

ACID and ALKALI-RESISTANT FOR CORROSIVE LIQUIDS

NYLON

Mildewproof and alkali-resistant. Wide range of weaves and widths.

DUST COLLECTION TUBES FOR ALL PURPOSES, FABRICATED TO YOUR SPECIFICATIONS

WM. W. STANLEY CO.
401 Broadway New York 13, N. Y.

SAVE UP TO 80%
OF WORK CLOTHES COST!

WORKLON industrial apparel of ACID RESISTANT DU PONT ORLON



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FREE! Rush WORKLON'S new and fully illustrated 16 page catalog of ORLON and COTTON WORK CLOTHES

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NEWARK *Metallic* FILTER CLOTHS

Weaves that STOP the Solids!



Enlargements 4X

Here are five different weaves of Newark Metallic Filter Cloths. All different in the arrangement of the strands; hence different also in their functioning.

Study the shape of the solids in your solution being filtered. That's just as important as the size, if you want clarity of filtrate. Then write us fully about the solids and we'll be glad to recommend the weave of the cloth that will "stop" them.

Many malleable metals are still available so, if necessary, we can probably supply you with a material that will also withstand highly corrosive conditions. When writing, also give solution characteristics.

All Newark Filter Cloths are woven in our own plant, on our own looms, by our own skilled weavers.

Our entire line of Filter Cloths, Wire Mesh and Space Cloth, Sieves, "End-Shak" Testing Units and other Newark Products are described fully in our new Catalog D. Send for a copy.

NEWARK for ACCURACY

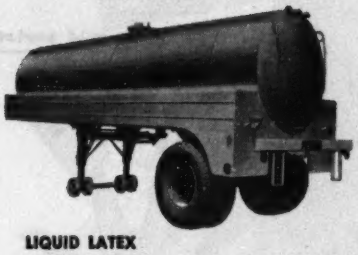
Newark Wire Cloth COMPANY

351 VERONA AVENUE • NEWARK 4, NEW JERSEY

Philadelphia 3, Penna. 1211 Widener Bldg. | San Francisco, Calif. 3100 19th St. | Chicago, Ill. 30 N. Wacker Dr. | New Orleans, La. 520 Maritime Bldg. | Los Angeles, Calif. 1400 So. Alameda St. | Houston, Texas P. O. Box 1879



SULPHURIC ACID
TANK-TRAILERS



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CAUSTIC SODA
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HOW LONG WILL IT STAND UP?

Is It Right For Your Job?

Will It Profit Your Business?

IS IT WORTH THE PRICE?



Judge a Trailer BY ITS VALUE!

PRICE ALONE is no criterion when you're buying a Trailer. There are some bargains that aren't bargains at all, if you ask this question: "Does the Trailer have the exact specifications it *needs* to do my job?"

When you put a Fruehauf into service, you know it will stay there, hard at work — an asset to your business because of its *low* maintenance cost — because it is specifically engineered by the world's most experienced Tank-Trailer manufacturer to haul a certain type of liquid chemical. It has feature after feature to give you profitable, dependable hauling for many more years than you can ordinarily expect. Many of these Fruehauf features, such as the tire-saving Gravity Tandem Underconstruction, are exclusive—you can't get them elsewhere at any price.

Compare the specifications, as well as the prices, next time you buy a Trailer. Compare the *value*, to be sure you're getting your money's worth. You will always be sure of *full* value with a Fruehauf.

Fruehauf TRAILERS
"ENGINEERED TRANSPORTATION"

World's Largest Builder of Truck-Trailers

FRUEHAUF TRAILER COMPANY

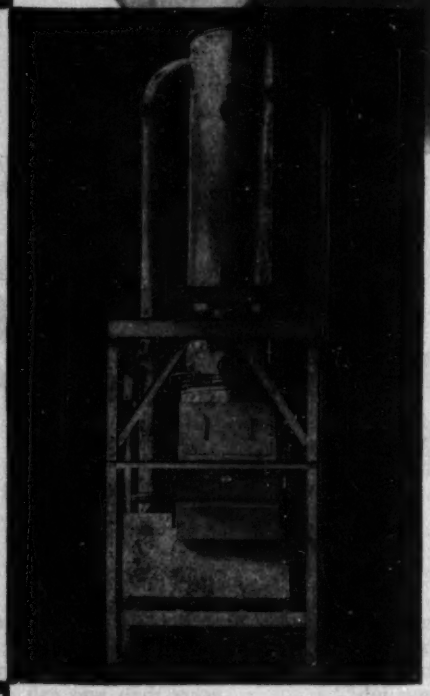
Detroit 32, Michigan

FOR ANY CHEMICAL HAULING JOB—THE BEST BUY IS A FRUEHAUF!

"What is your processing problem?"



***If your process involves a liquid that will solidify when cooled.... ....this machine can do it....then discharge and size the substance.... all automatically**



If you have a processing problem, perhaps the Vogt Automatic Tube-Type Molding Machine will provide the answer because it will form and size any liquid that will solidify when cooled, and will discharge by gravity upon heating.

Now in use by major chemical companies, these units have achieved tremendous savings in labor while producing a more uniform product. Also, since the process involves "freezing" or solidifying the substance while it circulates through tubes, the quality of the product is often superior to that of the original charge.

The wide range of uses to which Vogt Tube-Type Molding Machines have been adapted indicates their definite value in the chemical processing field. Adaptation possibilities are virtually unlimited and you may request detailed technical information from our engineers without obligation.

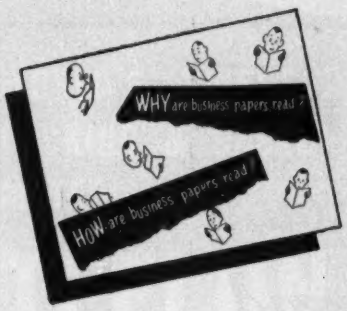
Vogt

Automatic Tube-Type

MOLDING MACHINE

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.



A copy of this quick-reading, 8-page booklet is yours for the asking. It contains many facts on the benefits derived from your business paper and tips on how to read more profitably. Write for the "WHY and HOW booklet."

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McGraw-Hill Publishing Company, Room 2710, 330 West 42nd St., New York 36, N. Y.

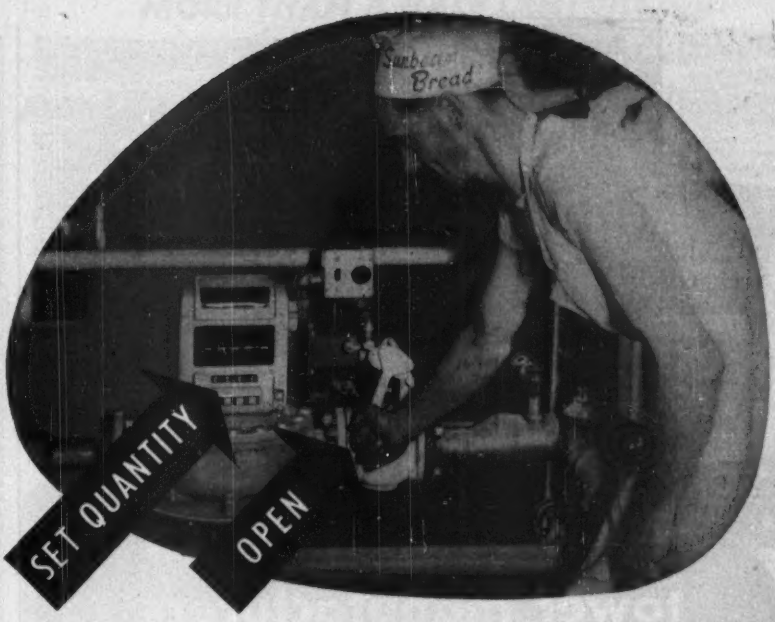


Just a flick of a switch, then read the Brookfield dial, and you have your viscosity determination in centipoises. The whole operation, including cleaning up, *takes only a minute or two.*

Available in a variety of models suitable for extremely accurate work with both Newtonian and non-Newtonian materials, Brookfield Viscometers are portable and plug in any A.C. outlet. *Write today.*

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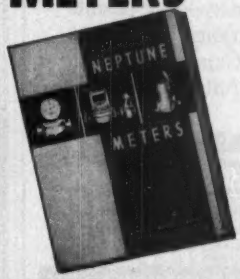
BROOKFIELD ENGINEERING LABORATORIES, INC.



Exact Automatic Formula Control WITH NEPTUNE METERS

Hitting formulas "on the nose" time after time is automatic with these new Neptune Auto-Stop liquid meters. With an Auto-Stop on every liquid line feeding into the batch or blending, the operator simply pushes buttons to set the number of gallons or pounds required by the formula. He then opens the valve and the meter does the rest, shutting off at the exact quantity.

Neptune meters pay for themselves by eliminating spoilage, spillage, over-filling and the unsanitary muss and fuss of gauge sticks, pails or batch tanks. They stop waste of valuable ingredients and prevent over-dilution with water that must later be removed. Their accurate figures take the guesswork out of inventory control too. The Neptune Auto-Stop is only one of many Neptune meters available for handling over a hundred different industrial liquids. Why not ask for a complete plant survey at no obligation?



Send for new Neptune Liquid Meter Bulletin 566-M

NEPTUNE METER COMPANY

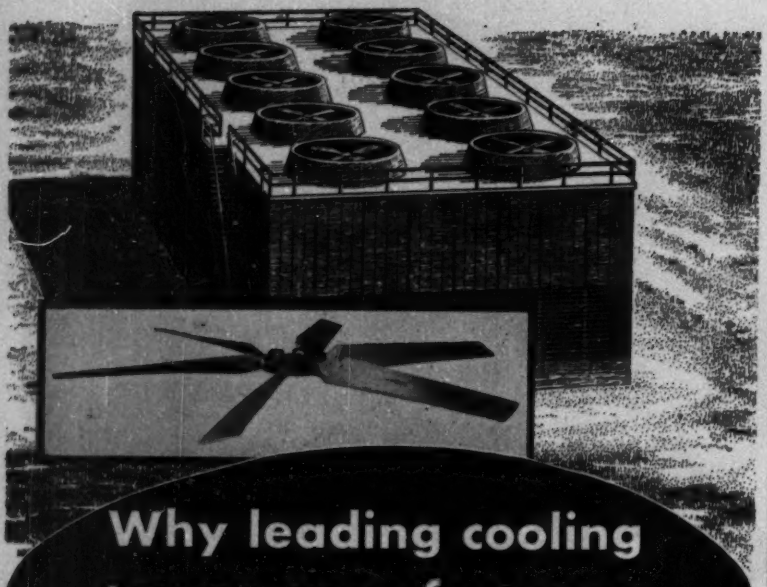
50 West 50th Street, New York 20, N. Y.

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1. Adapted high-speed, top-efficiency aircraft propeller design
2. Engineering service for special installations
3. Longer life—improved anti-flutter performance
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Koppers Aeromaster Fans are available for diesel motors, pumping stations, chemical processes, air-conditioning systems—any sizable industrial cooling requirement. Standard models range from 5 to 24 ft. diameters, with 4, 6, or 8 blades per fan. Capacities up to 1,000,000 cubic feet of air per minute. Every fan is fully guaranteed.

KOPPERS

Aeromaster FANS

Manufactured by the Metal Products Division of Koppers Co., Inc., which also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators and Gas Apparatus.

Engineered Products Sold with Service

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224 Scott St., Baltimore 3, Md.
Gentlemen: Please send me detailed information on Aeromaster Fans for

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(name and type of equipment to be cooled)

Name.....

Title.....

Company.....

City.....Zone.....State.....

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. . . and clipped pertinent ideas, articles and advertisements for reference, *please do not burn or throw it away.*

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1) Wastepaper can help to swell the funds of your local Boy Scout Troop, your church or other community organization. It gets a good price these days.

2) Whether in magazine form or not, wastepaper helps to fill the increasing need for paper pulp brought on by the mobilization effort.

Collect it. Give it to your favorite organization. Chances are they have scheduled pick-ups.

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TEFLON

IS PROCESSED BEST BY CHEMICAL & POWER PRODUCTS

BECAUSE:

Whether your need is for V. type packing expansion joints, machined or molded parts or for Teflon in sheets, rods and tubes you can't beat Chemical & Power Products record of:

EXPERIENCE: First manufacturer of satisfactory resilient Teflon packing in the U. S.

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Convince yourself that Chem-Power is the right source for you. Send for Catalog and price list today.

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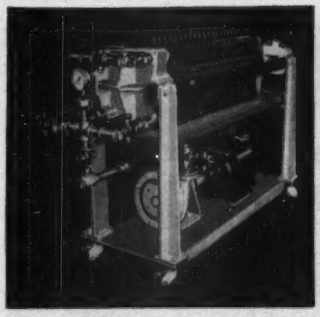
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Proves **SHRIVER FILTER PRESSES**



One of many filter presses for clarifying and for recovery, washing and partial drying of filter cake in fine chemical manufacture.

More **VERSATILE • EFFICIENT WIDELY APPLICABLE**



Shriver stainless steel, washing type filter press, complete with feed pump, on portable stand.

The performance history of thousands upon thousands in service today and the unabated demand for more to meet the needs of expanding process industries prove Shriver Filter Presses—

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- Applicable for almost any filterable material.
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City ..... Zone ..... State .....

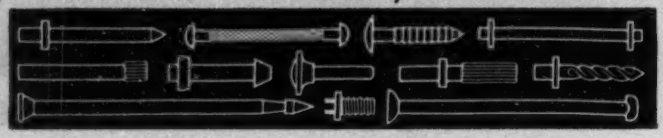
T. SHRIVER & COMPANY, Inc., 802 Hamilton Street, Harrison, N. J.

WRITE FOR Hassall FREE fastener catalog



A complete, comprehensive handbook on cold-headed nails, rivets, screws and other special fasteners. Check on ways to improve your assembly cost-wise, appearance-wise and from a standpoint of maximum effectiveness at minimum cost. One hundred years of experience are at your service. Write for price quotations or for suggestions on the redesigning of your present assembly.

JOHN HASSALL, INC. 144 CLAY STREET BKLYN. 22, N.Y.



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ANTHRAFILT*

. . . through years of efficient use . . . has become an accepted standard of excellence in the filtering field, so that today it is recognized for its filtering ability, superiority, and the many savings it provides.

ANTHRAFILT*

is made from a selected Pennsylvania Anthracite low in ash, high in anthraxylon, low friability, and right shape. Its low ash content is further lowered by special cleaning.

USES INCLUDE

RAPID GRAVITY FILTERS
PRESSURE FILTERS
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SWIMMING POOL FILTERS
OIL REMOVAL FILTERS
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PORTABLE FILTERS

ANTHRAFILT* provides greater capacity . . . longer filter runs . . . cleaner washings at lower cost . . . removes entrained turbidity from industrial process solutions or wastes.

Write us today for full details and recommendations. A prompt reply is assured.

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822 East 8th St., P. O. Box 1696, Erie, Pa.

* *Trade Mark Reg. U. S. Pat. Off.*

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VIKING
AN HONORED NAME IN PUMPING

Installed in 1945, in the industrial adhesive manufacturing plant of F. G. Findley Company, Milwaukee, these two Viking Pumps have given maximum service with minimum attention and **without repair costs.** They have handled thousands of barrels of adhesives with viscosities from 100 cps to 3000 cps, with temperatures from 70 to 165 degrees F.

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Anthracite Institute Building
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TANK-O-METER
FOR MEASURING TANK CONTENTS ANY DISTANCE AWAY

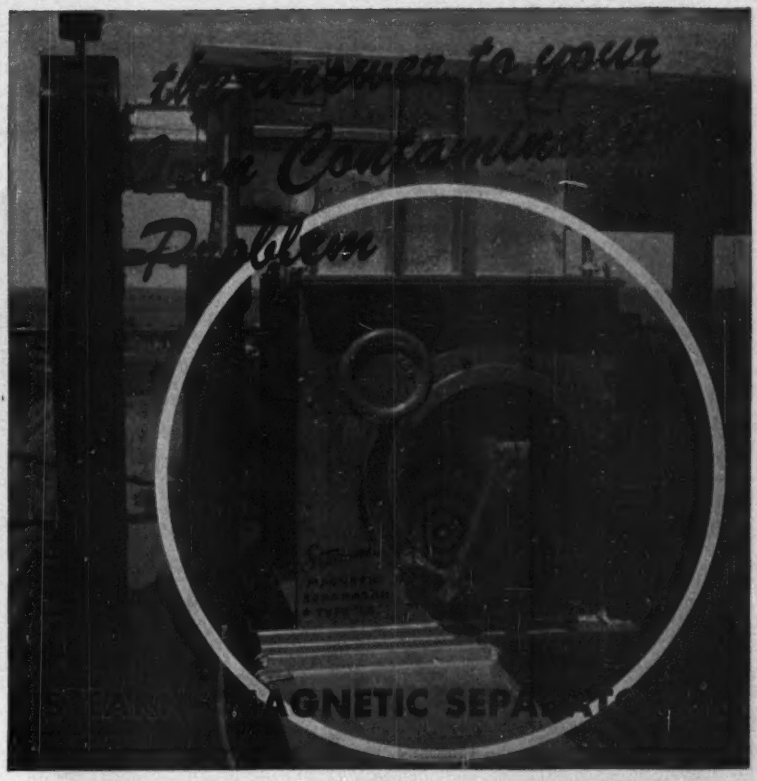


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CARBON BLACK PURIFIED
with
Stearns MAGNETIC SEPARATOR

Removing iron scale from carbon black is everyday work for a STEARNS Magnetic Separator. And that's exactly the story of the STEARNS Type "LS" pictured above for a large Southern processor of carbon black. To be used in the manufacture of ink, the product is kept iron free the dependable, automatic way with a STEARNS Magnetic Separator.

YOUR PRODUCT

Whether you are handling carbon black, chemicals, plastics, starch, grain or some other granular product, a STEARNS Magnetic Separator is your best bet to purify your product and protect expensive pulverizers and grinders. Avoid shutdowns and costly repairs — remove all tramp iron the low cost dependable way with a STEARNS Magnetic Separator.

A SEPARATOR FOR EVERY NEED

Electro and permanent magnetic separators, pulleys, filters, plate magnets, spouts and drums — all EXPERIENCE ENGINEERED to meet your requirements.



Type "LS" (left) and Type "LP" (right) are particularly designed for dust-tight applications and are built as a complete unit for direct attachment to spouts and chutes. Electro and permanent magnetic models available in all sizes. Write for descriptive literature.



1011

MAGNETIC EQUIPMENT FOR ALL INDUSTRY

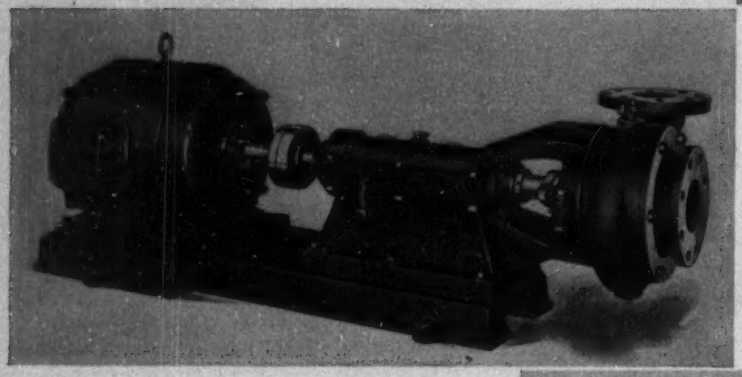
STEARNS MAGNETS

STEARNS MAGNETIC, INC.
629 South 28th Street Milwaukee 46, Wis.

"Buffalo" Tips on Better Pumping

• Pump selection has become a job for specialists. The increasing variety of liquids being handled has broadened the types of pumps to the point that today the engineer can name his liquid characteristics, pressure, Net Positive Suction Head and other details, and receive the exact pump made for the job. And that, from the standpoint of maintenance and operating cost, is the cheapest pump. Shown are two of the complete range of "Buffalo" Chemical Pumps ready to handle *your* special jobs.

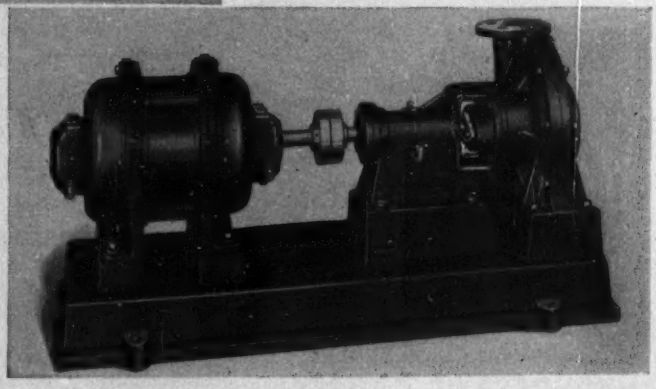
The Lowest Cost PUMP is the One Built For the Job



IN MOST MACHINEABLE ALLOYS— these "Buffalo" Single Suction Full Ball Bearing Pumps may be had in iron, bronze, stainless steel, Hastelloy "B" and "C", nickel in sizes 5 to 900 gpm for heads up to 160′. Readily accessible stuffing box and impeller. A sturdy, precision-built pump.

RUBBER-LINED

Here is a "Buffalo" Pump to handle chlorinated solutions, concentrated hydrochloric, solutions containing abrasive solids, many of chemistry's most corrosive liquids. WRITE TODAY for Bulletin 982 and see the full line-up of "Buffalo" Pumps serving today's highly specialized chemical requirements without worrisome repairs and replacements.



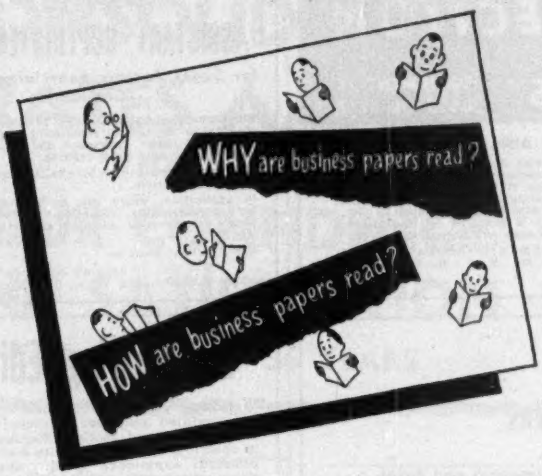
BUFFALO "Buffalo" PUMPS, INC.

501 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

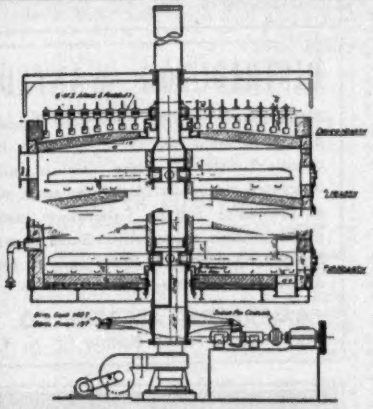
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



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ROASTERS

for efficient roasting and calcining of

ores, clays, limestone, limestone mud;

decomposing oil sludge in the process of recovering sulphuric acid; incinerating sewage and garbage.

COAL, OIL OR GAS FIRED

Sizes 3½′ to 22′ inside dia., up to 12 hearths.

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A SUBSIDIARY OF THE MINE & SMELTER SUPPLY CO.

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METAL POWDERS

FLAKE
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GRAIN FORM

MAGNA MANUFACTURING CO., INC.

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THE MERRICK FEEDOWEIGHT

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SINGLE OR DOUBLE

For prices and information

WRITE TO THE CLEVELAND MIXER CO
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SINGLE OR DOUBLE

For prices and information

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Cleveland 9, Ohio

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501 Chemsteel Bldg., Walnut St., Pittsburgh 32, Pa.

Send data on Engineering & Construction facilities for ACID-ALKALI-PROOF CONSTRUCTION of processing & storage tanks & flooring.

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Discount of 10% if full payment is made in advance for 4 consecutive insertions.
EQUIPMENT WANTED or FOR SALE Advertisements acceptable only in Displayed Style.

Individual Spaces with border rules for prominent display of advertisements.
The advertising rate is $14.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column. 3 columns—30 inches—to a page.
NEW ADVERTISEMENTS—Address New York office, 330 W. 42 St., N. Y. 36, for the June closing May 4th. C.E.

CHEMICAL ENGINEERS
METALLURGICAL ENGINEERS

Permanent positions open in operating and process research and development departments in Gulf Coast area for engineers with B.S. or M.S. degrees and 1 to 3 years' experience.

Company is engaged in large expansion of sulphur mining activities and research and development in other minerals.

Information on company policies, benefits and working conditions will be furnished when you send in detailed resume to Personnel Department. Replies held confidential, of course.

FREEPORT SULPHUR COMPANY
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New Orleans 5, Louisiana

MECHANICAL PROCESS ENGINEERS

For fast growing process engineering department of old established company.

Top-notch design engineers experienced in stress analysis as applied to process vessels and design of machine components, familiar with fabricating practices. Experience on plant engineering staff desirable.

Please address replies to:

LUKENS STEEL COMPANY
Attn: Supervisor of Employment
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CHEMICAL ENGINEERS
An active, confidential service!
Interview at your convenience.
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GLADYS HUNTING (Consultant)
DRAKE PERSONNEL, INC.
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$9000 Start
A staff level administrative spot for a man with good industrial coatings background. Company pays our fee.
Contact Barney Kimball
O'SHEA EMPLOYMENT SYSTEM
AMERICA'S LARGEST
64-E Jackson, Chicago 64, Wabash 2-1884

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

CHEMISTS AND Chemical Engineers Wanted. The Tennessee Valley Authority wants Chemists and Chemical Engineers to carry on inorganic research and development activities in chemical plants at Wilson Dam, Alabama. Several vacancies also exist for Chemists for plant chemical control work. Salaries start at $4575 and $5450 for 40-hour week. All Jobs carry automatic within-grade increases for satisfactory service, liberal vacation leave, sick leave, and retirement benefits. Write to Tennessee Valley Authority, Division of Personnel, Knoxville, Tennessee.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500 to $35,000. We offer the original personal employment service (established 43 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 362 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL, $3,000-$25,000. This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection, under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. B, 241 Orange St., New Haven, Conn.

SELLING OPPORTUNITY OFFERED

MANUFACTURERS REPRESENTATIVE solicited, water stills, sterilizers, and hospital and laboratory equipment manufactured by the Consolidated Machine Corporation, 49 Sudbury St., Boston 14, Mass.

Additional Employment and Business Opportunity Advertising on Page 514

WANTED
ASSISTANT SUPERINTENDENT
for Sugar Factory near large city in Canada

Requirements: Approximately 30 years of age, chemical or mechanical engineering degree, several years beet sugar experience and possibly some knowledge of cane sugar refining.

Good permanent position for qualified man, starting as soon as possible.

In application, which will be kept confidential, state personal data, education, experience, references, remuneration expected and attach photograph.

Reply without delay to

P-7201, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

Engineering Editor

Permanent position with good opportunity for qualified engineer attracted to technical editing and writing. Requires degree in chemical engineering with 3-10 years of practical experience in the chemical or chemical process industries. Prefer experience in production, development, engineering or design work. Must be alert, able to think logically and write clearly. Location Metropolitan New York. Please state personal data, education, experience, references and salary requirements.

P-7420, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

ASSISTANT CHIEF CHEMIST and CHEMIST

for large copper company Chile, South America. Must be experienced in analytical work of all kinds, including complete analysis of ferrous and non-ferrous metals etc. Three year contract. Transportation both ways and salary while traveling paid by Company. In reply give complete details.

P-7561, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

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Manufacturer widely advertised brand of Dynel industrial clothing which is chemical resistant, water resistant, mildewproof wants distributor for south or southwestern states. Laboratory tests prove product superiority. Sales curve headed up and up! Write or wire for details to Sales Manager.

AMERICAN ALLSAFE CO.
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Immediate Openings for Chemists Chemical Engineers

We now have positions available in practically all fields, including technical service and sales. Salaries range from $4,000 to $8,000. Openings in all sections of the country. Write or phone for full particulars. Your inquiry held in confidence.

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Phone Financial 6-1155
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THANKS TO YOUR CONFIDENCE AND SATISFACTION

FOR THE PAST 36 YEARS

36 YEARS AGO

Back in 1917, American industry was staggered by the stoppage of her importation of chemicals. Our most crucial lack was potash, the price soaring to more than $600 a ton.

In the same year saw the creation of the Chemical Foundation, Inc., and issuance of licenses for the use of German chemical patents. This ended the German world dye monopoly, and opened a new era of the American Chemical Industry.

From the files of Chemical Engineering

"CONSOLIDATED"
SERVING THIS INDUSTRY SINCE 1917

PRICED TO SELL

5—Devine #28 Vacuum Shelf Dryers, each 20 shelves 59" x 78", surface condensers and vacuum pumps.
2—Ball & Jewell #2 Rotary Cutters.
1—Tolhurst 48" steel basket Centrifugal, susp, type, bottom discharge.
4—Traylor Tube Mills, 5' x 22', 5' x 20', 4'6" x 18'6", 4' x 13', each stone-lined, scoop feed, pebble charge, clutch pulley.

Still installed in one plant as operated with all accessories as used.

ROTARY KILNS & DRYERS

2—7'x60' Calciners, made by Struthers Wells. Each 9/16" shell, Timken roller bearing supports, F-B gear reducer, with V-belted AC motor, firing hood, seal ring, one with Manitowoc Recuperator, all in excellent condition and priced for quick action.
1—7'6"x125'; 1—8'x135' Allis Chalmers Rotary Kilns.
1—6'6" I.D. x 12' Rotary Nodulizer, ⅜" shell, Timken roller bearing rolls, gear reducer and motor drive.
3—3'x50' Rot. D.H. Dryers or Coolers.
4—Ruggles-Coles Direct Heat Rotary Dryers—Class XF4—54"x25', 1 Class XF 5'x40'. Three 3'x30'; 5'x30'; 5'x50'; 6'x40'; 6'x60'; 7'x70'.
6—Link-Belt Roto-Louvre Dryers; #207-10 (2'7"x10'), #310-16, #503-10, #604-20, two #604-24.
3—6'x50' Louisville Rotary Steam Tube.
1—5'x33' Rotary Vacuum Dryer, jacketed Shell; 1—20"x8', jacketed, with dust collector and condenser.

FILTER EQUIPMENT

2—#12 Sweetland Filters for 36 leaves on 4" c.c.
8—Shriver 42"x42", Iron Filter Presses, Plate & Frame, 10, 27, 36, 54 chambers, 1" cake.
16—Sperry 18"x18", Iron, P & F, Filter Presses, close delivery, 11 chambers.
1—American Disc Filter 6' dia., 2 disc, 100 sq. ft. filtering area, with auxiliaries.
1—Shriver, iron, steam heated, 30"x30", 20 chambers, 1" cake.
1—6'x12' Oliver Lead-Wood Vacuum Filter Acid-Resisting.
3—Oliver Vacuum Filters, incl. 8x112', 11'6"x14', 11'6"x18'.
1—Sperry 24"x24" P & F Filter Press with 25 chambers, 2" frames.
1—#7 Sweetland Filter with 20 steel leaves, 4" c.c., NEW 1951.

WE BUY YOUR IDLE EQUIPMENT



SINGLE ITEMS

COMPLETE PLANTS



SEND US YOUR LIST TODAY!

EVAPORATORS

1—Quadruple Effect Evaporator, calandria type, brass tubes, 14,000 sq. ft. H.S.; excellent condition; still erected; complete with piping, etc.
3—Mojonnier S/S Vac. Pans, 3', 4', 5', 6'.

JACKETED KETTLES

1—Patterson Fdry. 500 gal. steel, jacketed, closed, agitated Kettle.
36—S/S Jacketed Kettles, up to 1000 gal., some agitated.
17—S/S Vert. & Horiz. open and closed Storage Tanks, up to 2000 gal.
6—Dopp C.I. 80, 100, 150, 350, 600 gal.
7—Steel, agitated, 350, 500, 700, 800.
3—9500 gal., welded, agitated, open.
29—Aluminum and Copper, 30 gal. to 800 gal., some agitated.

DRY POWDER MIXERS

1—12,000# Jack., horiz., Ribbon Mixer.
1—Sturtevant 2000# Rotary; 1—Howes 1800# dbl. ribbon; 1—Munson Rotary 1000# batch; 1—Ransome ½ ton; 1—Readco Ribbon 700#; 2—Day 800# and 400#.

HIGH SPEED MILLS

5—J. H. Day type B, 14" x 30", 3 roll High Speed Roller Mills, with all roller bearings and watercooled rolls —silent chain drive.

DOUBLE DRUM DRYERS

1—42" x 120" Buflovak Atmospheric S/S Conveyors, S/S Elevator, S/S Hood.
1—5' x 12' Buflovak Atmospheric.
2—32" x 90" Buflovak Atmospheric.
1—32" x 72" Buflovak Atmospheric.

PEBBLE MILLS

All porcelain lined
1—Abbe 5' x 6', 10 H.P. motor.
2—5' x 4', 235 gal.
2—6' x 8', 800 gal.
1—Abbe #4, 125 gal., 45" x 42".
3—Abbe, 25 gal. and 50 gal.

VIBRATING SCREENS

1—Tyler Hummer 4'x10', 2 deck, with 2 vibrators and generator set.
1—Battery of two 3'x5". Tyler Hummer, Type 33, with Generator Set for both.
1—3'x8' Selectro, single deck.
1—3'x8' Selectro, double deck—rebuilt.
1—18"x5' Selectro—rebuilt.
2—Day Ro Ball Size 82, dbl. deck, 40"x120".
1—Rotex, sql. deck, 20"x48".

PULVERIZERS

1—Raymond 5-roll, high side.
3—Mikro Pulverizers, 2SI, 4TH.
1—6"x15" Sturtevant Jaw Crusher, to ½".
1—24"x15" Sturtevant Crushing Rolls, balanced type.

MISCELLANEOUS

2—Stainless horiz. 13,500 gal. welded Tanks, agitated.
3—Anco 4'x9' Chilling Rolls.
2—Pneumatic Scale packaging lines.
2—Buflovak 6' dia. Vacuum Crystallizers; 1—6' dia. Atmospheric, jacketed.
1—6'x14' Hardinge Rotary Counter Current Classifier, also for dewatering or scrubbing.
2—Dorr two-stage Classifiers, each with two rakes, total length 27', gear reducer and motor.
1—Davenport #3A Dewaterer, with speed reducer and 5 HP AC motor.
1—Mechanical Cooker, 5' dia. x 16 long, jacketed, agitated, Insur. Certificate.
1—20 gal. jacketed, dbl. sigma bladed Baker Perkins Mixer, M.D.
1—Patterson, 110 gal. S. S. Vacuum Mixer, dbl. sigma blades, M.D.

NEW STAINLESS STEEL FABRICATION

We have available excellent facilities for fabricating Stainless Steel Tanks, Kettles, Condensers, Reactors, Autoclaves, Distillation Columns, Filter Presses, Heat Exchangers, etc.
ASME Code Construction
Will gladly furnish estimates to your specifications.

ONLY A PARTIAL LIST. TELL US WHAT YOU NEED.

CONSOLIDATED PRODUCTS CO., INC.

LARGEST AND OLDEST DEALER IN REBUILT PROCESSING EQUIPMENT

2015 PARK ROW BLDG., NEW YORK 38, N. Y., BArclay 7-0600, Cable Address: EQUIPMENT, N. Y.

POSITIONS WANTED
(Continued from page 512)

ADMINISTRATIVE CHEMICAL Engineer—Registered P.E., Age 37, experienced production, plant, general superintendent, production manager; fifteen years chemical plant administrative experience in alcohol, whiskey, rayon-cellophane, fertilizer, sulfuric acid, soybean oil solvent extraction, submerged fermentations, commercial yeast, riboflavin, Vitamin B-12. Also interested other fields. Very adaptable. PW-7466, Chemical Engineering.

CHEMICAL ENGINEERING Coordinator — B.Ch.E.; R.P.I.; 34; with 10-year mechanical-chemical background in operating, staff and design project engineering desires to join small California growth-minded chemical, plastic or equipment company. Proven results obtained with large chemical company in developing, selling and applying improved manufacturing and engineering equipment and technique for increased profitability. PW-7560, Chemical Engineering.

SELLING OPPORTUNITIES WANTED

MANUFACTURER'S REPRESENTATIVE, handling nationally known dust control line, desires additional line in Eastern Penna., Maryland and Delaware. Professional Engineer. RA-7514, Chemical Engineering.

ESTABLISHED CHEMICAL Processing Equipment, construction material, or maintenance line, applicable to chemical industry, for the States of Tennessee, Kentucky, Virginia, and North Carolina. RA-7513, Chemical Engineering.

MANUFACTURERS' REPRESENTATIVE, graduate Mechanical Engineer and Metallurgist, desires additional products relating to flow and handling of corrosive liquids. Area, Eastern Pennsylvania, South Jersey through Virginia. RA-7465, Chemical Engineering.

PACIFIC COAST REPRESENTATIVES

We have transferred our office to California and are interested in representing reliable manufacturers of CHEMICALS-METALS-INDUSTRIAL PRODUCTS

CHARLES VERMILYE COMPANY
(formerly of 500-5th Ave. N. Y. City)
3440 Wilshire Blvd. Los Angeles 5, Calif.

Important French company—headquarters in Paris—specialist in the construction of oil refineries and chemical products plants developing a new field of copper-smithing (important manufacturing possibilities) wants to get in contact with American firm for obtaining manufacturing license for appliances of interest to oil or chemical products (stainless steel, nickel, monel, soft steel, etc.). Write first letter No. 64 Agence MAILLE—7 rue des Italiens—Paris.

ELECTROLYTIC PROCESS

Low Voltage Direct Current available for Electrolytic process work. Approx. 1500 KW.

BO-6705, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

CALIFORNIA PLANTS FOR SALE or LEASE

New INDUSTRIAL SURVEY gives current facts on plant sites and factories available in Metropolitan Oakland Area (MOA) where tremendous growth spells PROFIT. Sites in urban, suburban and rural areas. Plants to meet your individual requirements built for you on sites you select. 220 national firms already enjoy MOA advantages: savings in shipping time and cost; major terminals for rail, truck, sea, air carriers; all-season production and demand; phenomenal, continuing G-R-O-W-T-H. Serve the multi-billion dollar West market from this hub location. Send for your free Data sheet outlining facts available in our Industrial Survey. Address:

Alameda County New Industries Committee
Suite B, 427 - 13th St. Oakland, Calif.

Available { CUSTOM REFINING FACILITIES
• Distillation • Extractions
• Separations • Fractionation
Drum Lots—Tank Cars

Wanted { • All Types of Crude Mixtures
• By-Products, Residues, Wastes
Contaminated Solvents

TRULAND CHEMICAL & ENGINEERING CO., INC.

Box 426, Union, N. J. UNionville 2-7360

FOR SALE

Available for prompt delivery, new Cast-in Coil Kettle, 5'0" dia. x 6'2" deep dished bottom, at a reduced price. Kettle designed for 40 PSI and tested to 80 PSI hydrostatic pressure. Kettle equipped with 7 sets of coils.

BLAW-KNOX COMPANY
BUFLOVAK EQUIPMENT DIVISION
1543 Fillmore Ave., Buffalo 11, N. Y.

WANTED

READY TO BUY

Dyes - Chemicals - Pigments - Waxes
Plasticizers - Solvents - Colors
By-Products - Wastes - Equipment

CHEMICAL SERVICE CORP.
80-04 Beaver St. New York 5, N. Y.

WANTED

Vacuum Dryers, Heavy Duty Mixers, Reactors, Kettles, Columns, Rotary Filter, Pulverizers, Filter Presses, S/S and non corrosive Tankage. Idle or Set Up Plant.

P. O. BOX 1351
Chuch St. Sta. New York 8, N. Y.

WANTED

Used Storage Tanks, 6000-50,000 gal. individual capacity; High-pressure Boiler, 150-250 HP capacity; Glycerine evaporator and Still; Equipped Laboratory.

W-7329, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

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Latest Type Metallurgical and Chemical Equipment

Excellent Condition

Hardinge Conical Ball Mill 10' x 48"
Vulcan Rotary Kiln 8' dia. x 80'
Dorr Causticising Equipment
Oliver Rotary Vacuum Filters All Iron
Dorr Type A Thickeners
Sampling Mill—Crusher, Rolls
Link Belt Screw & Belt Conveyors
Turbo Mixer Agitators
Norblo & Sly Dust Collectors
Hardinge Feedometers
Oliver, Dorr, Morris, Worthington process pumps
Tanks and Bins
Instruments and Controls

The above items include all auxiliary equipment with individual motor and control 220/440/3/60. The equipment may be inspected on foundations.

Complete List with Specifications Available.

THE VULCAN DETINNING CO.

SEWAREN, N. J.

DEPENDABLE PROCESS EQUIPMENT

All Items In Stock . . . Ready for Your Inspection And Immediate Delivery

S. S. Steam jacket kettles up to 250 gal.
Powder mixers 50 to 2000 pounds
Charlotte Colloid Mills, M3 & M50
Buflovac Dbl. Drum atmospheric Dryer 42x100
Pfaudler 10 gal. jacketed glass lined reactor w/ agitation
Laughlin Horiz. Continuous Filter
S. S. Tanks 50 to 2000 gal. agitation avail.
Boilers 2 h.p. to 500 h.p. Oil or Gas Fired
Mikro Pulverizer 4-TH with extra screens
Lehman 5-roll Mill 12" x 36" water cooled
30 Fairbanks Morse Hammer Mills 2000 to 4000 lbs cap.
J. H. Day Robell Sifter size 81, screen 40" x 120"
La Bour Acid Pumps
Proctor and Schwartz 84 tray dryer
Portable Electric Liquid Mixers 1/3 to 3 h.p.

We Buy and Sell Complete Plants or Single Items

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NEWMAN TALLOW & SOAP MACHINERY CO. INC.
ESTABLISHED IN 1899
1051-59 WEST 35TH STREET
CHICAGO 9, ILLINOIS

HORIZONTAL MIXERS

2—1500# cap. dope mixers, glass lined, lgth. 11' dia. 5', steel constr.

2—1500# cap, dope mixers, glass lined, lgth. 10' dia. 4', cast iron constr., steam jacketed, 15# press.

These units are self-supporting bases, motr. driven. Prices and further information on request.

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EVERDUR TANK

54x126" Whitlock storage tank with copper heating coils for heating 6000 gallons of water from 40° F to 180° F. With steam at atmospheric pressure. Tank built for 100 lb. working pressure. Coils can be used with steam at 100 lbs. working pressure.

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COLUMNS—STILLS

2 Aluminum Bubble Cap Columns, 36" dia. x 45 plate.
1 Aluminum Bubble Cap Column, 27" dia. x 18 plate.
1 Aluminum Perforated Plate Column, 28" dia. x 36" plate.
2 Copper Bubble Cap Columns 6' dia.
1 Copper Beer Still Column 6' dia.
1 Copper Column with 18—30" dia. perforated plates and 10—24" dia. bubble cap plates.

CONDENSERS—EXCHANGERS

3 Aluminum tub. 166 sq. ft.
15 Alum. Coil Exch. 47 sq. ft.
7 Copper tub. 20, 65, 90, 140, 1350 sq. ft.
4 S.S. tub. 8½, 180, 330 & 400 sq. ft.
3 S.S. Coil Condensers, 40 sq. ft., 60# pr.

DRYERS—EVAPORATORS

1 Stokes #59A Jacketed Vacuum Rotary Dryer, 18" dia. x 42" long.
2 Atm. Double Drum Dryers, 22" x 38".
1 Cummer Rotary Hot Air Dryer, 46" dia. x 26' long.

FILTERS

1 Sweetland #10, 21 lvs.
1 Sweetland #12, 72 lvs.
1 Swenson Rotary Continuous Vacuum Filter: Precoat type, 8' dia. x 8' face, rubber covered and lead acid proof construction.
1 FEINC Rotary Vacuum Filter, string discharge, 4'6" dia. x 6' face, aluminum.
4 Pressure Leaf Filters, 70 to 90 sq. ft.
2 Shriver 36" Filter Presses, rubber covered, closed dely., washing, hydr. closing.
1 Louisville 8-roll Continuous Filter or Grains Press 24".

NOW LIQUIDATING

Equipment of Patrick Henry Brewery, Marion, Indiana:
16—Horiz. Welded Steel Tanks, dished heads: 10,500, 11,300 and 12,700 gal.
6—3500 gal. Vertical Closed Welded Steel Tanks, dished heads.
22—8300 gal. Welded Steel Rectang. open top tanks—16'10" L x 7'7" W x 8'9" H.
1—4000 gal. Vertical Steel Cooker, Jktd., Agit.
1—Dracco Pneumatic Grain Conveying System.
1—Sperry 24" C.I. Filter Press, 16 Ch.
1—Ammonia Compressor with motor: 10 x 10 (82 ton).
1—Steel Shell & Tube Condenser: 1000 sq. ft.
Lot of miscellaneous equipment—pumps, coolers, scales, kettles, tanks, bottling machinery, etc.

JUST PURCHASED

4—Stainless Steel Bubble Cap Columns, 6' dia. x 30' high, 20 plates, Type 347 St. St.
4—650 ton Hydraulic Presses, 27" x 27", 18" dia. rams..
2—Stokes RD-3 rotary 15-punch pellet presses
1—Shriver 36" C. I. Filter Press, 20 chamber, closed dely.
2—1000 gal. Rectang. Stainless Steel Tanks.
2—St. St. Shell & Tube Heat Exchangers, 368 sq. ft. ea.
1—Buffovak Atm. Double Drum Dryer, 24" x 36".
2—Tyler Hummer Screens 3-deck, 4' x 5'.
1—Stainless Steel Pressure Vessel, 600# WP, T304, 18" dia. x 9'4" L.
140—Stainless Steel Flanged Gate Valves, 1", 1½", 2" & 3".
6000 ft. Stainless Steel Tubing, T304, 16 ga., 1½" & 2" OD, 6' lengths.
1—1250 gal. Stainless Steel Tank with coils, closed top, ¼" T304, Agit.

CHEMICAL PLANT

2—St. St. Jktd. Agit. Tanks, 450 gal.
3—St. St. Vacuum Tanks, 260 gal.
6—St. St. Tanks, 15, 100, 150, 200 gal.
1—St. St. Exchanger, 23 sq. ft.
1—St. St. Column 8" D x 26' H.
1—St. St. Purification system — 110 gal. Kettle, 55 sq. ft. vaporizer, 12" dia. column, 73 sq. ft. condenser.
3—Adams St. St. Filters.
3—Worthite Pumps.
2—Shriver St. St. Diaphragm Pumps.

KETTLES—REACTORS

1 Stainless Steel, Type 347 Autoclave or pressure tank, 250# pr., Elec. heated 850° F; 17¼" dia. x 9' high.
70 Stainless Steel and Stainless Clad open top, steam jacketed kettles—10, 40, 60, 80, 100, 150, 250, 500 gal. sizes.
1 Stainless Steel Kettle, 950 gal., 20# jkt. pr., vertical agitator. Type 347 shell, bolted C.I. top.
3 300 gal. T316 Stainless Steel Jacketed Tanks, 10# jkt. double motion agit.
1 200 gal. Read Stainless Steel Jacketed Kettle, double motion agit. 10 HP.
4 Aluminum Reaction Kettles, Jktd. & Agit., 25, 60, 100 gal. and 250 gal.

MILLS—PULVERIZERS

1 Paul Abbe #6 Pebble Mill, porcelain lined, 32" x 36".
1 Hardinge Conical Ball Mill, Steel Liner, 4'6" dia. x24" long.
1 Williams Hammer Mill, type AK; size A, stainless steel.
5 Mikro Pulverizers, #1-SH, #1-SI, #2-SI, #2-TH.
2 Premier Colloid Mills, 6" st. st. rotor, type U-3 & V-3.
1 Acme #8½A Jaw Crusher.

TANKS

35 Aluminum Tanks, closed, 4, 275, 330, 480, 500, 1350 & 1450, 9000 gal.
13 Horiz. Welded Steel Tanks, Lastiglas Lined, 15,200 gal.
1 Vertical Rubber Lined, 6000 gal. open.
5 Vertical Jacketed Pressure Tanks—Steel—30# steam jacket—6mm vacuum internally:
3—34" ID x 15' H (approx. 700 gal.)
1—23" ID x 10' H (approx. 230 gal.)
1—23" ID x 9' H (approx. 195 gal.)
8 15,000 gal. Vertical Welded Steel Closed Fermenting Tanks, 80 lbs. W.P., turbine agitator with 40 HP motor; 970 lin. ft. 3" pipe coil. Excellent condition.

STAINLESS STEEL TANKS IN STOCK

1 5700 gal. Horiz. T304—NEW
1 4200 gal. Vert. closed, T304—NEW
7 3000 gal. Horizontal Stainless Steel 1000 gal. sizes
50 Stainless Steel Tanks—from 9 gal. to 1 1000 gal. Vert. T316 Closed Tanks, 5'4" dia. x 18'9" long, insulated and agitated. Excellent for transporting, storage or holding.

MISCELLANEOUS

1 Bin, 275 cu. ft., T316, St. St.
2 Bird Susp. Centrifugals, 48" dia. Stainless Steel Perforated Baskets.
1 Fletcher 30" Jr. Centrifugal Extractor, St. St. Imperf. basket.
5 DeLaval Centrifuges, models #600, 74-11 and 94-01.
2 Kux Machine Co. Model 25 Rotary Pellet Presses, 21 and 25 punch.
3 Stokes Rotary Pellet Presses, 16 punch, B-2, D-3.
4 Selectro Vibrating Screens, stainless steel, 2' x 7', double deck, enclosed.
1 Stainless Steel Horizontal Steriliser 10# pr., 24" W x 28" H x 36" L.
1 Stokes Vertical Steel Jacketed Vacuum Chamber and Impregnating tank, 30" L x 25" W x 24" D.
2 Vertical Agitators—40 HP gearmotor with Turbo #5B drive, 70 RPM.
1 Porter heavy duty jacketed double worm mixer—75 gal.

STAINLESS STEEL FABRICATION

"Heliarc" welding. Water-quenched welds (if specified). Specializing in lighter weight tanks (10 ga., 12 ga., 14 ga., 16 ga., etc.). Large quantity of type 304 and type 316 sheets carried in stock assuring quick delivery of tanks built to your specifications. Over 30 NEW tanks in stock for immediate shipment—from 30 gal. to 5700 gal. sizes.
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International Stainless Steel Straightline Vacuum Filler, 160 per minute.

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F.M.C. Kyler A adj. Wraparound Labeler.

Burt automatic Wraparound Labeler.

S. & S. G1, G2 and G6 Auger Fillers.

Colton 2, 3RP Rotary Tablet Machines.

Stokes 2 Cream Filler and Closer.

Triangle Elec-Tri-Pak G2C, A6CA Fillers.

Filler 4-Head and Hope 6-Head Stainless Steel Piston Fillers.

2000 gal., 500 gal. Jacketed Mixing Tanks.

Horix S. S. 14-Head Rotary Filler.

Standard Knapp No. 429 Carton Sealer.

Mikro 4TH, 3TH, 2TH, 1SH and Bantam Pulverizers; Schutz-O'Neil Mills.

Tri-Homo #5 Colloid Mill, 7½ HP.

3500 gal. working cap. Steam Jacketed, Double Arm Mixing Tanks for mixing, storing or processing of your materials.

Day 650 gal. Steam Jacketed Mixer.

B. P. 150 gal. Unidor S. J. D. A. Mixer.

Stokes, Day, New Era, Hottman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.

Baker Perkins and Readco Heavy Duty 6 to 150 gals. Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.

J. H. Day 8 gal. Pony Mixer.

Day 100, 800, 1500, 10,000 lbs. Dry Powder Mixers and Sifters.

Lee 85 gal. S. S. Jacketed Mixing Kettle.

Pony M, ML Labelrites; World and Ermold Rotary and Straightway Labelers.

Shriver 24" Jacketed, Oliver, Sweetland #2, Sparkler, Alsop Filters.

Pneumatic Scale Cartoning Line.

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Hayssen 8-18 adj. Wrapper for Kraft or cellophane.

Hudson Sharp Campbell 2W6 high-speed automatic cellophane Wrapper.

Package Machy. DF, FA4, FA Wrappers.

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WE OFFER

DRYERS

2—8x40' Rotary Hot Air.
1—4½x28' Rotary Direct Heat, oil.
2—42x120" double drum atmospheric.
1—6x32' Rotary—direct heat.
1—Kemp 400CFM. Dynamic Dryer.
1—Davenport #3A bronze rotary Press.

Centrifugals and Clarifiers

1—30" Tolhurst suspended imperf. basket.
1 set 3—36" American suspended (two with stain. steel perforate basket.)
1—40" Tolhurst suspended rubber covered perforate basket.
2—De Laval 54-B1 Clarifiers, 3 hp.
3—Sharples airtight Clarifier, stain. steel, 3 hp.

Evaporators and Vacuum Pans

1—New 36" Henssey st. steel Vacuum Pan.
1—Mojonnier 26" stain. steel.
1—Rogers 42" st. steel dbl. effect Vacuum Pan.
1—20 gal. Stokes st. steel Vacuum Pan.
1—Swenson sgl. eff. Evapora[illegible] 120 sq.ft.
1—Swenson quad. eff. Evapor[illegible] 3500 sq.ft.
1—Zaremba trip. eff. Evaporator, 1500 sq.ft.
1—Swenson trip. eff. Evaporator, 850 sq.ft.

Filtration Equipment

12—Cast Iron recessed and plate and frame Filter Presses, 7" to 36".
1—Aluminum 30" 40-chamber P&F. press.
1—Lead 24" 38-chamber P&F. press.
1—Oliver 3x4' phosphor bronze.
1—Oliver 8x14' Filter.
1—Oliver pressure, iron, 110 sq.ft.
5—Alsop, Lomax internal pressure Filters, stain. steel and bronze.

MILLS

1—Attrition, Sprout-Waldron 20".
12—Pebble and Jar Mills, 1 to 235 gal.
5—Colloid Mills and Homogenizers, 3 to 15 hp.
10—Hammer Mills, ¾ to 50 hp.
2—Pot Mills, cast iron, 18 and 36".
6—3-roll Mills, Day, 12x32" and 16x40".
1—2-roll Rubber Mill, Birmingham, 12x24".

MIXERS

1—Readco 250 gal. work. cap. stain. steel dbl. arm, 50 hp.
7—Baker-Perkins, Read, Lynn-Superior dbl. arm, 1 gal. to 100 gal.
2—Day 3000# jacketed horizontal ribbon.
10—Day, Robinson Powder type, 50 to 2000#.
3—2 hp. Alsop 1150 RPM. portable type.
6—Steel Mixing Tanks, 50 to 800 gal.

TANKS

30—Stainless Steel (some with agitators) new and used, up to 10,000 gal.
2—1000 gal. steel jacketed (100 psi.) open top.

Special Offering — Before Removal. Pfaudler glass lined Distilling Unit.: 300 gal. Reactor, Condenser, Forewarming Tank, Storage Tank, Reflux Condenser, Receiver, etc.

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For Sale **For Sale**

1—Eppenbach Stainless Steel Home Mixer, complete with a 7½ HP Explosion-Proof Motor.
1—Baker-Perkins 100 Gal. Stainless Steel Mixer, double-arm, sigma blades, with 20 hp explosion-proof motor.
1—J. H. Day #2, 75 Gal. Brighton Mixer.
5—Pebble Mills 40 to 500 Gal.
10—Pony Mixers, 8, 15 and 40 Gal.
HIGH SPEED Roller Mills 9"x24" to 18"x40".
1—Motor Driven Belt Conveyor.
3—6" Premier Colloid Mills, watercooled.
2—#281 Mikro-Pulverizers with 10 hp Motors.

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CLASSIFIERS: 4—Akins and Wemco 54" x 33 ft., Simplex, single screw, high weir, with syneregear motor. 220/440 volt, with lifting device. Condition like new, available now. Located Nevada.

FLOTATION EQUIPMENT: 7 banks, 9 cells each, 45 cu. ft. units, complete with blowers, agitators, etc. Used only 6 months, condition like new.

WEMCO SINK FLOAT MOBILE MILL: 360 tons per day, new condition.

LOCOMOTIVE CRANE: Link Belt 25 ton capacity, standard R. R. gauge, gasoline powered, cast steel trucks, air brakes, with or without 1-¼ yd. Williams clam shell bucket, thoroughly modern, excellent condition. Located Minnesota.

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STEEL STORAGE TANKS

5—8' x 45'—½", 80 LB. PRES.
3—30,000 Gal. 11' x 43' x 5/16" Horiz.
12—10,000 & 20,000 Gal. 5/16" Horiz.
14—4,000 & 10,000 Gal. R.R. Car Tanks.
6—1,000, 5,000 & 10,000 Bbl. Vert.
Located ILL., N. Y., KANS. & GA.
LESTAN CORP. ROSEMONT, PA.



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Outstanding Selections Backed by Our Quarter Century of Service and Dependability!

DRYERS—KILNS

1—Vulcan 7'x160', ⅜" shell, two 12" tires complete.
1—Vulcan 7'x120', ⅜" shell, two 12" tires complete.
1—Ames 6'x60', ½" shell, two 8" tires.
1—5'6"x25', ½" shell, two 6" tires.
1—Louisville 38"x25' steel Hot Air Rotary Dryer.
4—Rotary Dryers 7'x60', 5'x67', 4'6"x40', 3'x25'.
2—Hersey 6'x23', 5'x23' Hot Air Rotary Dryers.
4—Louisville Steam Tube Dryers 6'x50', 6'x30', 5'x28', 3'x20'.
1—Devine double door vacuum shelf Dryer, having 17-159"x78" shelves.
4—Devine single door vacuum shelf Dryers, having 20, 8, 6 and 4-40"x43" shelves.
5—Stokes & Buflovak Rotary Vacuum Dryers 30"x8', 3'x15', 6'6"x38'.
5—Buflovak 60"x144", 42"x120", 32"x90" Atmospheric Double Drum.
1—Single Drum 60"x80" Flaker.
1—14 Truck steam heated Dryer 1680 sq. ft.
3—Buflovak 6' diameter, Vacuum and Atmospheric Crystallizers.

FILTERS

2—Oliver Monel 8'x10' Rotary-Vacs.
1—Oliver SS 8'x10' Rotary-Vac.
2—Feinc Monel 5'x3' Rotary-Vacs.
3—Oliver 5'3"x3', 3'x1' Rotary Vacuum Enclosed Precoat.
8—Oliver Rotary Vacuum 11'6"x18', 11'6" x14', 8'x12', 8'x10', 8'x8', 8'x6', 3'x1'.
2—Eimco Rotary-Vac 4'x5', 4'x4'.
1—Feinc steel 8'x12' Rotary-Vac.
2—Sweetland #12 with 72 and 36 leaves.
1—Sweetland #10 with 18 leaves.
1—Sweetland #7 with 27 leaves.
3—Vallez 500 sq. ft. Rotary Pressure.
1—Sperry 36" Recessed, 48 chambers, c.i., open delivery.
5—Shriver 30" P&F, 30 chambers, c.i., open delivery.
8—Sperry 24" P&F, 16 chambers, c.i., closed delivery.
1—Shriver 24" Recessed, 30 chambers, c.i., open delivery.
3—Shriver 18" Recessed, 30 chambers, c.i., open delivery.
2—Sperry Aluminum 30" and 24" P&F, 22 and 26 chambers.
10—Shriver Sperry Filter Press Skeletons 42" to 18".

CENTRIFUGALS

1—Fletcher 48" Suspended Aluminum bottom discharge, perforated basket, motor driven.
1—Fletcher 40" Suspended, SS, bottom discharge, perforated basket.
1—Tolhurst 32" Suspended Monel, bottom discharge, perforated.
1—Fletcher 30" Suspended Steel, bottom discharge, perforated.
1—Tolhurst 30" Suspended Rubber, bottom discharge, perforated.
1—Tolhurst 26" Suspended, steel, bottom discharge, perforated.
2—Bird 36"x50" solid bowl, rubber and stainless.
4—Bird 36"x72", 36"x50", 24"x38", 18"x 28" solid bowl continuous, steel.
2—Sharples #16P Monel Super Centrifuge.

LOOK!

1—New Vulcan 8'x80' Rotary Kiln.
1—Hersey 4'x26' Monel Hot Air Rotary Dryer.
1—Hersey 3'x24' Stainless Steel Hot Air Rotary Dyrer.
1—Electro Dryer, size X, Type CH, 3000 cu.ft.
1—Kritzer Lime Hydrator, 6 stage, 14' dia.
1—Goslin Birmingham 4'x8' solid nickel Flaker.
1—Link Belt 2'7"x8' Monel Roto-Louvre Dryer.
2—Milton Roy Duplex Proportioning Pumps, 212 GPH at 1500# pressure.
1—Baker Perkins 35 gal. stainless steel, jacketed, double arm Mixer, Sigma Blades.
1—Day 50 gal. stainless steel jacketed, double arm Mixer, Sigma Blades.
4—Pfaudler New 1500, 1000 gal. glass lined Reactors.
1—#2TH stainless steel Mikro Pulverizer.
1—Shriver 36" C.I. Filter Press, P & F, 42 chambers.
4—Closed stainless steel Tanks 1500 and 1000 gal.
1—Hardinge 4½' x 16" Conical steel lined Ball Mill 30 HP.
1—Banbury #1A Mixer with 100/50 HP motor.
5—Heat Exchangers stainless steel shell and tubes 50 to 300 sq.ft.
2—Pfaudler 100 gal. glass-lined Stills with condensers and receivers.

PULVERIZERS

1—Bauer 36" Attrition Mill 2-50 HP mtrs.
8—Patterson 6'x8', 5'x6', 4'x5', 4'x4½' Pebble Mills.
5—Abbe 3'x4', 3'x3½' Pebble Mills.
2—Premier Colloid Mills 8" dia., SS.
1—Eppenbach QV7 Colloid Mill.
2—Jeffrey 36"x24", 20"x12" Hammer Mills.
3—Raymond, Gayco Mechanical Separators 14', 12', 4'.
1—Two Roll Rubber Mill 6"x12".
2—Mikro No. 1S1, No. 1SH Pulverizers.
1—Fitzpatrick Comminuting Mill, 5 HP.
2—Sturtevant 5"x8" Roll Crushers.

SCREENS

5—Sprout Waldron SS, single deck, 40"x 84".
1—Day Ro-Ball single deck 40"x120".
4—Rotex #42, #22, and #11 single and double deck Screens.
1—Robinson double deck 20"x50".
5—Tyler Hummer 3'x5' triple deck.
6—Tyler Hummer 3'x15', 3'x10', 3'x5' single deck.
1—Abbe #2 Blutergess Sifter.
1—Selectro Double Deck 18"x48".

MIXERS

1—Baker Perkins JNM 100 gal. jacketed, double arm, sigma blades.
1—Baker Perkins Type V, 50 gal. jacketed, double arm sigma blades.
1—Baker Perkins 300 gal. Unidor stainless steel.
1—Readco 100 gal. jacketed, double arm, sigma blades.
1—Day 30 gal. Imperial, jacketed, double arm, sigma blades.
1—Baker Perkins ½ gal., jacketed.
1—Patterson 5' dia. Conical steel.
1—Day 2000# steel Powder Mixer.
1—Robinson 4000# steel Powder Mixer.
6—Rodgers 200 to 3000# Powder Mixers.
8—New Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gal. Pony Mixers.

MISCELLANEOUS

10—Bucket Elevators steel housing 34' to 60' centers, 8"x5", 10"x6" buckets.
1—Lummus 4' dia. steel bubble cap Column.
4—Buflovak, Zaremba and Kilby Evaporators, single and multiple effect, 300 to 16,000 sq. ft.
7—Stokes Vacuum Pumps 15 to 100 CFM.
5—Devine, Buflovak, Condensers and Receivers, 20 to 90 sq. ft.
1—Newman 2500# Soap Crutcher.
4—Groen 150, 125 gal. stainless steel, jacketed, agitated Kettles.
8—Stokes DD2, BB2, D4, D3 and B2 Rotary Tablet Machines.
4—38" dia. stainless steel Revolving Pans.
2—Nash #4, AL671 Vacuum Pumps.
7—Olivite, Duriron, rubber, Karbate and Haveg Centrifugal Pumps 6" to 2".

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CHEMICAL EQUIPMENT

AUTOCLAVE
2,000 gal., 200 PSI.

CENTRIFUGES
24" Bird, type CH, SS.
40" Fletcher, type 304 SS.
40" Tolhurst, perforated.

COLUMNS
24"x94"x⅛", rubber lined.
6'x29' type 347 SS, 21 trays.
8'x36'x⅜" (2—NEW).

DIGESTERS
3900 gal. jackt'd., agit. ASME 75 PSI.

DRYERS—MISC
30"x8' Stokes, Model 59AB, vacuum, rotary.
5'x6' Blaw-Knox, Drum, atmospheric.
24"x28' Proctor & Schwartz Conveyor.
6'x35' Louisville Steam Tube, complete.

FILTERS
8'x12' Feinc, rotary, vacuum.
8'x10' & 11'6"x18', Oliver.
No. 7 Sweetland, 172 sq. ft., 41 taps.
36" Shriver, C.I., 36 chambers.
12" Sperry, aluminum, 10 chambers.

HYDRATORS—ROTARY
5'6"x22' Buffalo (2).

KILNS—COOLERS—DRYERS
7'x160'x⅜" (2).
7'x120'x⅜".
7'x60'x⅜".
502-20 Rota Louvre.
5'6"x25'x9/16" Allis-Chalmers.
5'x30'x⅜" Ruggles Cole.
4'x60'x½".
4'6"x40'x⅜" Traylor.

MILLS
Raymond, 5 roll, high side, complete.
20"x36" Gruendler Hammermill.
6'x8' Abbe, Ball, type GPH (3).
2'x12' L. B. double shaft, Pug.

MIXERS
2190 cu. ft. Johnson, paddle type.
140 cu. ft. double shaft, paddle (NEW).
77 cu. ft. Blystone, heavy duty (2).

REACTORS—ACID GLASS
400 gal. Pfaudler, ASME.
500 gal. Pfaudler, ASME.

REACTORS—SS CLAD
3,000 gal. Jackt'd. ASME (NEW).

STORAGE TANKS
3400 gal. 7'4"x10'x⅜" type 430 SS.
4100 gal. 5'x28'x¼".
6000 gal. 8'x15'x⅜" vert. ALUMINUM.
6500 gal. TANK CAR TANKS, 76"x28'.
8500 gal. 8'x23'x5/16" vert. (NEW).
12,000 gal. 8'x32'x¼" (NEW).
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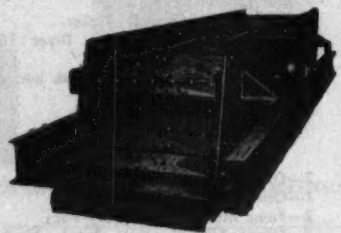
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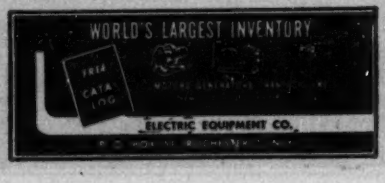
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3476	Copper Jacketed Still Pot; 28"x28" with condenser.
3459 R3	Aluminum Bubble Cap Column; 27¼"x36"; 40 plate.
3564	Copper Bubble Cap Column; 15"x12"; 24 plate.
C13-140	Stokes 1000 Gal. Copper Bubble Cap Column; 24"x13'.
C14-141	Stainless Packed Column; 24"x14' insulated.
C14-150	Steel Absorption Column; 12"x10'; 20 cu. ft. ceramic rings.
C14-151	Solvent Recovery Absorber; 8'x28' with accessories.
C14-152	Steel Scrubber Column; 36"x28'; domed heads.
C14-155	Gas Saturating Tower; 8'x36'6"; 5 PSI.
C15-154	Fractionating Tower in 2 sections; 24"x82'; 230 sq. ft. raschig rings.
3585	Stainless Flash Tank 8'x6' Type 316 S/S; with S/S Tube Bundle.
2755	Steel Still; 54"x36" with steel receiver 54"x96".
HCL-136	HCL Absorber; 28"x16'6" high with accessories.
C14-137	Stainless Steel High Pressure Scrubber; 12"x6',
3615	Monel Water Distillation Apparatus compression type; 22"x87".
3988 M2	Copper Jacketed Vacuum Still; 38½"x42".
3988 M3	Aluminum Steam Jacketed Vacuum Still; 48"x88".
E13-161	Harris Stainless Vac. Still with S/S coils; 6'x10'6" with accessories.
E13-162	Nickel Clad Evaporating Still; 6'6"x18'.
3476	Stainless Steel Bubble Cap Column; 16 sections; 8½"x19' high.

BALL and PEBBLE MILLS

M3-25	Patterson Steel Ball Mill Type D; 2'x3'; 7½ HP motor, belts, etc.
M3-26	Abbe Steel Ball Mill; 2'6"x3'6"; 7½ HP with steel balls.
M3-27	Meaco Jacketed Ball Mill; 4'x5'; 15 HP XPL Goerhead motor.
3443	Additional 5'x8' Pors. Lnd. Pebble Mills; 50 HP Goarmotors.
M14-36	Patterson Buhr lined Pebble Mill; 2'6"x3'6"; direct drive.
M14-29	Patterson Pors. Lined Pebble Mill; 3'6"x4'; direct drive.
3564	Abbe 50 Gal. Pors. Lnd. Pebble Mill; 30"x38".
M14-195	Abbe Buhr Lined Pebble Mill; 32"x36"; 2 HP motor.
3493	Abbe Buhrstone Lined Pebble Mills; 54"x60"; err. direct drive.
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M14-197	HK Porter Pors. Lined Pebble Mill; 5'x9'; 25 HP motor.
M14-196	Patterson Buhrstone Lined Pebble Mill; 6'x10'; 30 HP.
M8	Hardinge Conical Ball Mills from 22"x6" to 4'x20'; motorized.

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3259GS	Steel Ver. Autoclaves with tracks; 66" dia. x14'7" long.
3598	2500 Gal. Steel Jkt'd. Agitated Pressure Vessel; 8'x7'.
R4-262	Horizontal Steel Autoclave; 5'x16'; Jacketed; Agitated.
V4-383	Horizontal Steel Autoclave; 52" dia.x12'; with tracks.
V4-384	Adamson Autoclave; 6'x19'; with inner tracks.
V4-262	Glass Vulcanizer; ASME code; 6'x14'; quick open door.
R4-225	10 Pressure Steel Autoclave; 300 PSI; 6'x21' Jkt'd. Agtd.
V4-260	Steel Autoclave; 5'x26'; coil heated; tracks, pump, receiver.
R4-301	Globe Rotary Kier; 14' Diameter with 15 HP motor.
V4-385	Horizontal Heavy Steel Pressure Autoclave; 7'x36'; quick open doors.
R4-221	Struthers Wells Jacketed Steel Rotary Autoclave or Digester 100 PSI-ASME; 9'6"x12'; with 7½ HP motor.
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3497 S10	Hermans Bronze 12"x12" Press; 14 chamber
2729 R1	Ertel Multiple 3-Way Filter Press with 7 square 12" chambers and 7 round dise 12" chambers complete with pump.
3673 L4	Shriver 12"x12" Bronze P.&F. 9 chamber Press CI Dal. pump.
3673 L12	Perrin Bronze 12"x12" 4 eye, CI. Del. 7 chambers with pump.
3215	Shriver 18" Recessed C. I. 26 chamber Press; Open Delivery.
3673 L10	Shriver 18" Aluminum 10 chamber 4 eye; closed delivery.
F16-173	Shriver 24" Rubber Cov. Cast Iron 8 chamber Filter Press.
F16-733	Shriver 24" Nickel Plated 14 chamber Filter Press.
F16-734	Shriver 24" Aluminum 4 eye 24 chamber Closed Del. Press.
3328	Albright Nell Recessed 24" C.I. 40 chamber Filter Press.
F16-736	Shriver 30" Aluminum P.&F. 22 chamber Closed Del. Press.
3484	Shriver 30" Cast Iron 30 chamber Recessed Press Open Del.
3294 C4	Shriver 30" Rubber Cov. C.I. 34 chamber 2 eyed; Closed Del.
3183	Sperry 36" C.I. Type 41 P.&F. 34 chamber Press; 2 eye CI. Del.
3168	Sweetland Oliver Pressure Filter No. 2 12 leaves; 2' centers.
2536	Sweetland Filter No. 7; 41 Copper Leaves on 3" centers.
F14-733	Sweetland No. 30; 18 leaves on 3" Centers.
F14-737	Sweetland No. 12 Filter; 72 Copper leaves; on 2" centers.
3217	Bird Young Rotary Vacuum Filter; 6'x6'; Stainless Screens.
F15-150	Stainless Nat. Vac. Filter 3'x3' with accessories.
F15-151	Oliver Monel Vac. Filter 3'x3' with accessories.
F15-269	Oliver Borreo Coat. Nat. Vac. Filter 3'x3' accessories.
2729	Oliver Borreo Nat. Vac. Filter 6'x3' with nickel parts.
F15-290	Oliver Pressure Pre-Coat Filter 5'x8'; 130 sq. ft. lined with Type 316 Stainless.
F15-291	Oliver Borreo Type Vac. Filter; 8'x3'; monel screen; 3 HP.
F15-292	Oliver Continuous Filter 8'x6'; steel construction with Stainless accessories; variable speed drive.

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- Buffalo Double Drum Dryer; 42" x 120" complete with acc.
- Komarek Greaves Briquetting Press 2000 Pellets per M; 9 cu.ft. per hr.
- Hersey Gas Fired Atmospheric Dryer 5' x 26'; girth gear; 5 H.P. motor
- Simpson Intensive Mixer No. 1 48" Pan; 7½ HP motor; complete
- Jeffery Vibratory Cooler 57" x 10' with water cooled surface

REACTORS

3424R4	Stainless Reactor; oil heated agitated; 24 sq.
3861	Stainless Jkt'd. Agitated; 18"x24" with condenser.
3617	Stainless Jkt'd. Agitated Reactor; 24"x80".
3540	Glass Jkt'd. Autoclave; 300 psi; Agitated; 10"x15".
3871L9	Pfaudler Glass Lined Jkt'd. Reactor; 30"x28".
3544	Pfaudler Glass Lined Jkt'd. Reactor; 4'x6'; 75 PSI.
3424R2	Stainless 200 Gal. Agitated Reactor; 36"x30", Monel 250 Gal. Jkt'd. Agtd. Reactor; with Condenser and Accessories.
3670	Steel Reactor 4'x6' heated with copper coil unit.
3424R9	Stainless 475 Gal. Reactor 4'x8' Jacketed and Agitated.
3168	Stainless 500 Gal. Jacketed Reactor; 6' dia. x10' straight side.
3168D7	Doppler Jacketed Reactor; 40"x8' high.
3350	Buffalo 100 Gal. New Jkt'd Agtd. Reactor; 4'x8'; motorized.
3273	Pfaudler Glass Lined Jacketed, Agitated Reactor; 42"x51".
3434	Dopp 650 Gal. Cast Iron Full Jkt'd. Agitated Reactor; 66"x82".
R4-239	Stainless 500 Gal. Reactor with Reflux Condenser; 5 HP agitator.
3327	Copper Steam Jkt'd. Vacuum Reactor; 650 gal. 84"x72".
3113E2	Copper Vacuum Pan; coil heated; 3000 Gal. 9' diameter.
R4-227	Cast Iron 1800 Gal. Nitro Pot; 6'x8'; Agitated 5 HP motor.
3598	Steel 2000 Gal. Jkt'd. Agt. Reactor; 8'x7'.
R4-231	Stainless Steel Reactor; 2000 Gal. 7'6" dia. 125PSI internal.
R4-229	Steel Reactor; 3000 Gal. 15'3"x4'10"; Jacketed; Agitated.
R4-225	Steel Reactor; 3500 Gal. 6'x16'6"; Jacketed; Agitated.
2755	Steel Reactor; 54"x96" with steel Receiver, same size.

DRYERS (Atmospheric)

3868B1	P. & S. Continuous Apron Dryer; 12 Section; 41'6"L.x3'4"W.x14'6"H.
3868B1	P. & S. Apron Dryer; 13 unit; 9'W.x78'L. complete with accessories.
D8-147	P. & S. Apron Dryer; 12 Section; 5 Pass S/S belt; 9'4"W.x36'L.
3168	Louisville Monel Counter Current Atmospheric Dryer; 18"x12'.
D11-155	Louisville Rotary Steam Tube Dryers 5'x28' to 5'x30'.
D11-154	Davenport Rotary Steam Tube Dryers up to 7'x40'.
D11-158	Hahn Direct Fired Rot. Dryer; 3'x12' with accessories.
D11-159	Hersey Monel Direct Fired Rot. Dryer 3'x36' with accessories.

DRYERS (Rotary)

3595	Horizontal Steel Rot. Dryer or Cooker; Vac. Jkt. Agt. 4'x7'1½".
3382	Rotary Vacuum Dryer; 52"x102" with agitator and 40 HP motor.
D8-147	Stokes No. 59AA Rotary Vacuum Dryer; 24"x72" with accessories.
D8-144	Stokes 1000 Rotary Vacuum Dryer; 60"x18' long with accessories.

DRYERS (Drum)

1388M2A	Struthers Wells S/S Drum Dryer, 3'x10' with accessories.
3026	Buffalo Rot. Vac. Drum Dryers chrome plated 3'x12' complete.
3434	Rotary Drum Dryer in NICKEL; 48"x66".
3316	Bagley & Sewell Double Drum Dryer; 39"x88".
D8-150	Buffalo Double Drum Dryers; 52"x180"; 42"x180" and 60"x228".
D8-151	Buffalo Twin Drum Dryers; 32"x72" and 24"x92".

EVAPORATORS

1000C102	Goslin ming ham g ost Sextuple Effect, 10,200 sq. ft.
3274	Swenson Quadruple Effect Long Tube Evaporator; film type.
3475	Zaremba Single Cast Iron Evaporator; 130 sq. ft. Copper tubes.
2986	Devine Single Cast Iron Calandria type; 28"x5'.
3515	Acme 1000 Gal. Copper 6'x10', coils, barometric condenser, etc.
3557	Croll Reynolds Vac. Evaporators 30"x8' MONEL with accessories.
3570	Copper Vac. Evaporator; 66"x75" coils, heat exchanger.
437	Kahm & Nagel Continuous Evaporator; 3500 lbs. per hour.
E12-161	Buffalo Double Effect Evap. ...l. with copper steam chest, Barometric Condenser, etc. 75 and 100 sq. ft. each.
E12-162	Stainless Evaporator 61 dia. 285 sq. ft. coils Jkt'd Bottom.
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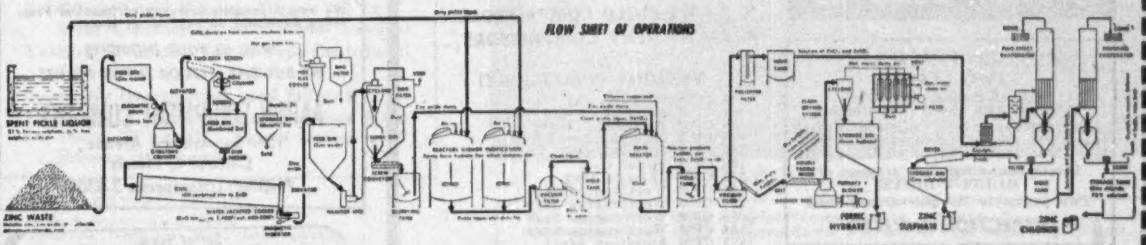
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3—PFAUDLER 3000 GAL. GLASS LINED STORAGE TANKS, Model POW, open top, welded construction, each 8' dia. x 8' deep, 3" bottom outlets.

1—LIGHTNIN' MODEL SEV 750 SIDE ENTERING AGITATOR with 20" monel propeller and bearing.

1—INTERNATIONAL SIZE NS-6 SIDE ENTERING AGITATOR with 3 HP motor.

2—FEINC 8' x 3' MONEL VACUUM FILTERS, string discharge, complete with wash and compression mechanism including agitator, motors, Nash L-3 vacuum pumps, 14" x 24" monel receiver, Worthite 1 CG-1 motor driven circulating pump. SEE PHOTO

3—BUFLOVAK MONEL EVAPORATORS, now arranged as double effect 148 sq. ft. per effect, one effect rapid concentration type, other effect vertical tube calandria, third effect 145 sq. ft. vertical tube calandria; can be used as 3 single or one triple effect, complete with condensers, ejectors, salt chambers, piping and all supports and accessories. SEE PHOTO

1—HERSEY 3' x 24' MONEL ROTARY DRYER, direct fire counter current for either natural gas or #3 oil motor drive with 3 HP motor, and #300 American Blower Fan. SEE PHOTO

2—MONEL STAND PIPES 12" OD, 1—5', 1—12' high.

1—WALLACE & TIERNAN CHLORINE EVAPORATOR, hot water recirculating type 50,000 BTU per hr. with pressure reducer and shut-off valve and flow meter.

1—RAYMOND FLASH DRYER, consisting of #40 **RAYMOND IMP MILL,** furnace, 40 HP motor, 6" x 20' screw conveyor, 9" double paddle mixer, recorder controller, and 10" belt conveyor. SEE PHOTO

1—SYNTRON ELECTRICAL VIBRATORY COOLER MODEL F-45 30" OD x 16" ID with cooling fins. Projection inward 3", length 5' 10".

1—KENNEDY #23½ GYRATORY FINE REDUCTION CRUSHER, roller bearing, gearless type with 40 HP motor and spare parts, Serial #1618.

1—KENNEDY SMOOTH ROLL CRUSHER 24" x 10" heavy duty chrome steel rolls, one roll smooth, other roll has Stoodite steel tips, 2—10 HP motors.

1—KENNEDY 4' x 60' ROTARY KILN, ½" plate, welded, with firing hood, air-seal, self aligning bearing, 10 HP motor and variable speed drive. SEE PHOTO

2—KENNEDY VIBRATING SCREENS type A 8' x 8' totally enclosed construction, 5 HP motors, one double deck, one single deck.

4—KENNEDY BUCKET ELEVATORS, #13 mill type, malleable iron chain, totally enclosed, 5 HP motors, 8" x 5" buckets, 42' 6", 37' 6", 37' and 25' centers.

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2—DURIRON MONEL PUMPS, Model 40 series M7B60, 100 GPM at 25' head.

2—DURIRON MONEL PUMPS, Model 40 series M7MD70, 100 GPM at 25' head.

9—WORTHITE STAINLESS STEEL PUMPS, Model 1CG1, 50 GPM at 35' head, motor drive with motor.

1—WORTHITE STAINLESS STEEL PUMP, 1½ CG1, 1 HP motor, 90 GPM at 40' head.

1—DEMING MONEL PUMP, Figure 40 BM #1 Standard motor drive, 2 HP motor, 50 GPM.

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3—Devine Vacuum Shelf Dryers, 5, 9.
1—Buflovak Double Drum Dryers, 32"x96".
1—Louisville Rotary Steam Tube Dryer, 6'x50'.
1—Kuhn Rotary Steam Tube Dryer, 3'x12'.
2—Buflovak Vacuum Drum Dryers, 24"x20".
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1—Simpson #1 Intensive Mixer.
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1—Gruendler #24-40 Hammer Mill.

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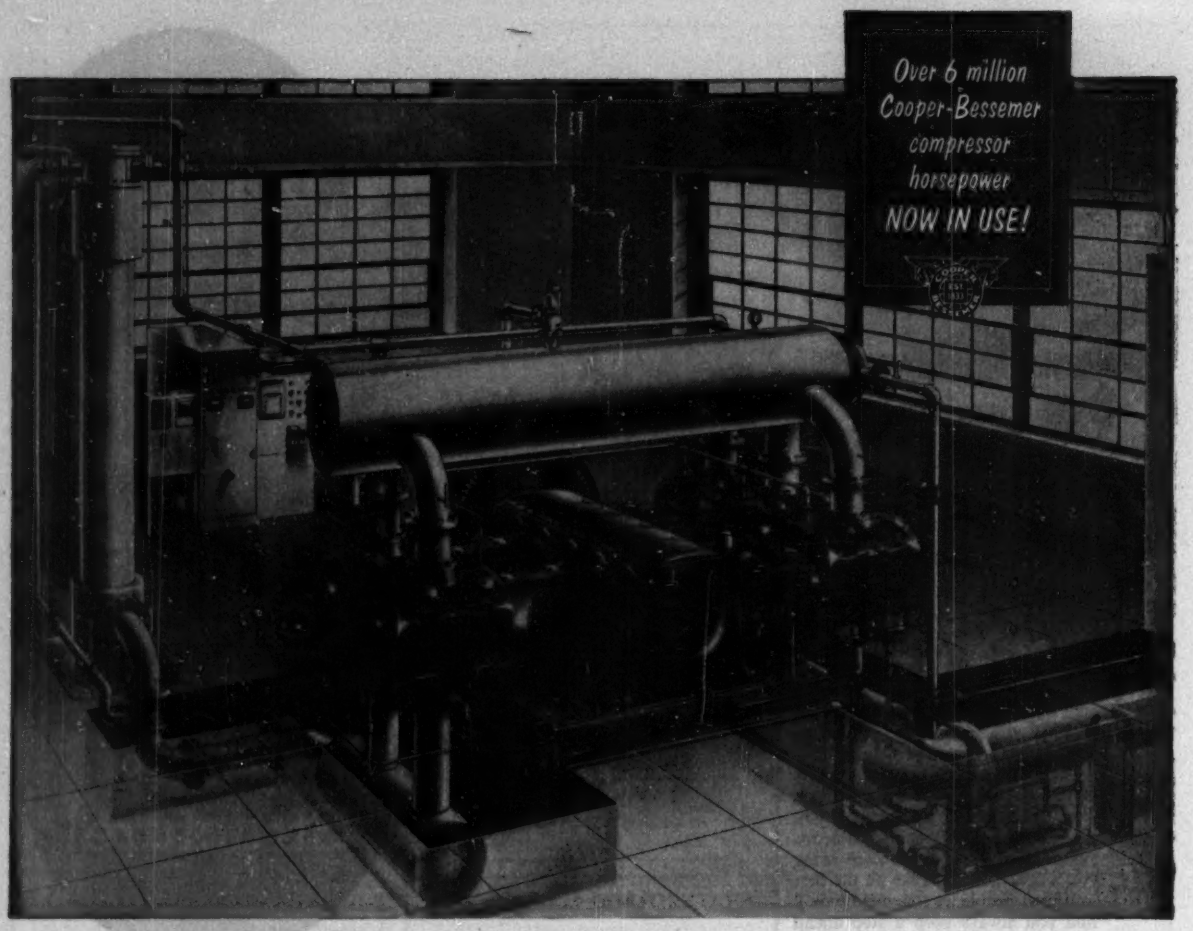
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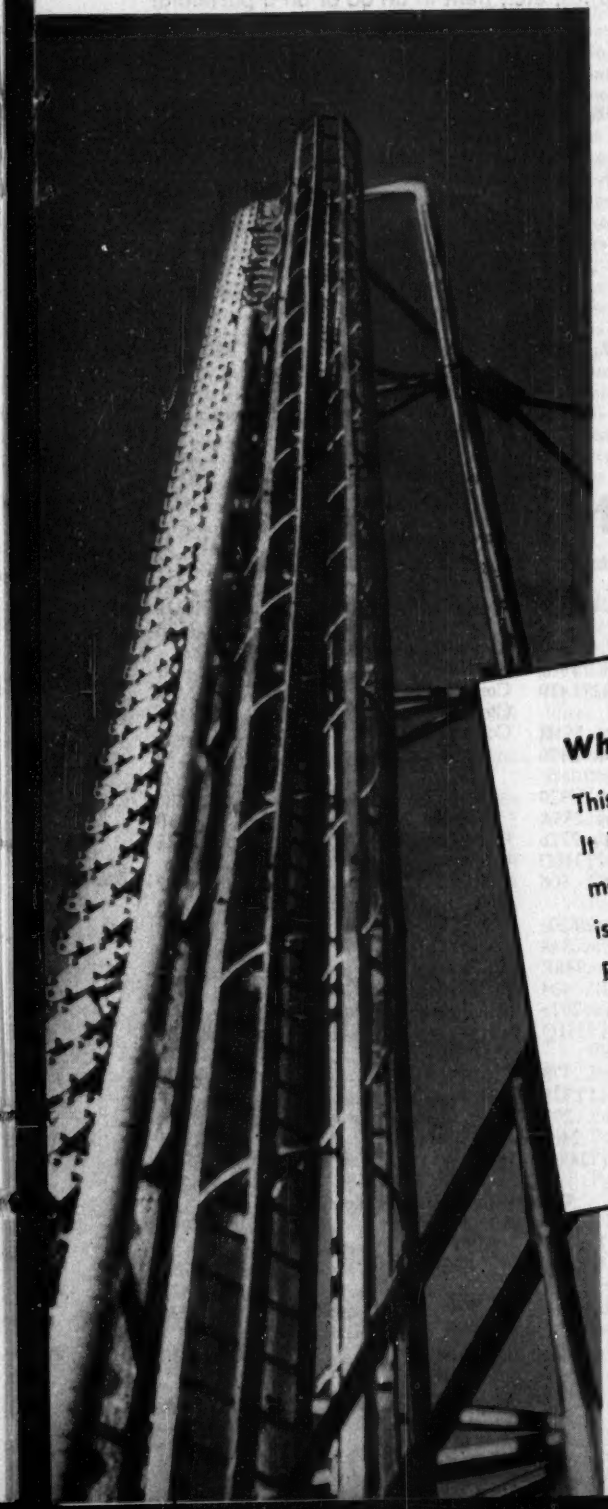
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Flashback . . .

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The listings on this and the following page is a repeat of the editorial listings only on chemicals, equipment and services featured last month in the New Equipment, New Products and New Technical Literature departments. Use the postcard below for more information on any item in this list.

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Two Postcards—To help you in keeping up-to-date

Chemicals, Equipment, Services, Reprints. Directions on the other side.

Chemical Engineering's Reader Service Postcard

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Company_____

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CHEMICAL ENGINEERING
READER SERVICE DEPARTMENT
330 WEST 42nd ST.
NEW YORK 36, N. Y.

Instruments...362F, 362U, 364C, 364L, 364S, 364U, 366I, 366N, 366T
Instruments
Analyze, infrared process.....358A
Cycling control valve.....259A
Electronic control 362H
Electronic recorders 362K
Electronic transmission 362I
Gas analysis apparatus.....261D
Geiger counters 366Q
Manual controls 362J
Measurement and control
Fluid flow 362B
Meters
Pressure 260A
Potentiometers
Indicator, portable 261E
Recorders 366F
Resistance thermometer 362L
Saybolt chromometer 261A
Signal relay unit 261B
Speed changer, miniature 261C
Timers 366E
Transmitter 362M
Insulation 364Q
Joint, rotary pressure.....244B
Junctions box
Explosion proof 255D
Vapor tight 255B
Lamp, mercury vapor gage.....244D
Light, moving beam warning.....250F
Liner, drum 256D
Materials handling equipment.....366C
Materials of construction
Weld metals 364M
Mixers 365C
Motor controls 362S
Motor, high slip 252B
O-Rings 365R
Painting equipment, spray.....364H
Pipe 362P
Pipe, plastic 366K
Pipelines 365G
Power systems, installation.....364N
Process equipment 365O
Pumps 364I, 366A, 366S
Pumps
Portable 366R
Positive 248A
Rotary 362D
Solids and acid handling.....362A
Submerged centrifugal 365M
Purifiers 366O
Roll, belt return 256F
Safety equipment
Respiratory protection 364O
Scoops, lift truck 257C
Screen, vibrating 243B
Seal, storage bunker 256C
Skid, magnesium barrel 257B
Switch
Heavy duty 254B
Heavy duty safety 250B
Tank cars 364J
Tape, draftin symbols.....250E
Temperature control 366L
Tray, distillation tower 242A
Trucks
Hand 257D
Lift and fork 256B
Tubing 362T
Valves 362E, 365B
Globe, angle check 362O
Water treatment 364G, 365P
Water treatment
Demineralizers 365Q
Ion exchange 365N

SERVICES

Consultants 365J

Two Postcards—One for you, one to pass along

Circle numbers of desired items, fill in reverse side, tear out and mail

CHEMICAL ENGINEERING: Send me more information about . . . (Card expires August 1)

. . . Items in this Reader Service section as circled below:

2	28-29j	66-67c	108	146	178	248C	258A	272e	294	B320	345e	348F	350R	B356	389	418b	442f	R473	496		
6	30-31a	69	109	147	180-181a	248D	256B	272d	295	321	346a	348G	350S	357	390	419	443	474	497		
7	30-31b	70	111	148	180-181b	248E	259	273e	T296a	T322	346b	348H	350T	359	391	420	444	L475	498a		
8	30-31c	71	113	149	180-181c	248F	260	272f	T296b	B322	346A	348I	351a	360	392	421	445	R475	498b		
9	32	72a	117	151	180-181d	248G	260A	272g	T296c	323	346B	348J	351b	361	393	422	446	L476	498c		
10	33	73b	119	152	182	248H	260B	272A	B296	T324	346C	348K	351c	T362	394	423	447	R476	500-501a		
11	34	74	121	153	183	248I	261	272B	297	B324	346D	348L	351A	B362	395	424	448	477	500-501b		
12	35-36	75	123a	154	184	249	261A	272C	298a	325	346E	348M	351B	363	396	425	R449	478a	500-501c		
13	37-38	76-77	123b	155	185a	250A	261B	272D	298b	T326	346F	348N	351C	364	397	426	450	478b	500-501d		
14	39	78	123c	156a	185b	250B	262A	272E	299	B326	346G	348O	351D	365	398	427	452a	479	TL502		
15	40	79	123d	156b	188	251	263A	273	301	327	346H	348P	351E	366	399	L428	452b	480	BL502		
16	41	80-81	123e	157	241	252	263B	275	303	T328	346I	348Q	351F	367	400-401	TR428	452c	481	R503		
17	42-43	83	125	158a	242A	252A	263C	279	304a	B328	346J	349	351G	368	402	429	452d	482	503		
18	44	84-85	126	158b	243A	252B	264A	280	304b	329	346K	350	351H	369	403	430	453	L483	504		
19	45	86	127	158c	243B	253A	264B	283	304c	L330	346L	350A	351I	370	404	431	454	R483	L505		
20-21a	46-47	87	128	159	243C	253B	264C	284	304d	B330	346M	350B	351J	371	405a	432	455	L484	R505		
20-21b	48	88-89	129	161	244A	254	264D	285	305	331	346N	350C	351K	372	405b	433	456	TR484	506		
20-21c	49	90	130	162	244B	254A	265	T286	307	332	346O	350D	351L	373	406	434	457	BR484	L507		
22	50-51	91	131a	163	244C	255	266	B286	309	333	346P	350E	351M	T374	407	435	458	455	R507		
23	52	92-93a	131b	164	244D	255A	266A	287a	311	334	346Q	350F	351N	B374	408	436	460-461	486	TL508		
24-25	53	92-93b	131c	165	244E	255B	267	287b	312	335	346R	350G	351O	377	409	437	462	487	BL508		
26-27	54-55	94	132	166	245	255C	268	T288	313	336	347a	350H	351P	378	410	438	463a	488a	R508		
28-29a	56	95	134	167	246A	255D	268A	B288	314a	337	347b	350I	351Q	T380	411	439	463b	488b	TL509		
28-29b	58-59a	96-97	135	168	246B	256	268B	289	314b	338	347c	350J	351R	B380	412	440	463c	488c	BL509		
28-29c	58-59b	98	136	169	246C	257A	269	T290	315	339	347d	350K	351S	T381	413	441	464-465	489	R509		
28-29d	61	99	137	170	246D	257B	270	B290	317	340	348	350L	351T	B381	414	442a	466	490	511		
28-29e	62-63	100-101	139	171	246E	257C	270A	291	T318a	342	348A	350M	351U	382	415	442b	468-469	491	525		
28-29f	64	102	140	172-173	246F	257D	270B	T292	T318b	343	348B	350N	352	383	416	442c	470	492-493	526		
28-29g	65	103	141	174-175	247	257E	271	B292	B318	344	348C	350O	353	385	417	442d	471	494	527		
28-29h	66-67a	104	142	176	248A	257F	272a	T293	319	345a	348D	350P	354	387	418a	442e	L473	495	528		
28-29i	66-67b	107	145	177	248B	258	272b	B293	T320	345b	348E	350Q	T355								

. . . Items in the Reader Service "Flashback" Section (p. 534)

242A	244E	250C	255A	256E	260A	262C	264C	272B	362F	362M	362T	364F	364M	364T	365E	365L	366A	366H	366O
243A	244F	250D	255B	256F	261A	263A	264D	272C	362G	362N	362U	364G	364N	364U	365F	365M	366B	366I	366P
243B	246A	250E	255C	257A	261B	263B	265A	362A	362H	362O	364A	364H	364O	364V	365G	365N	366C	366J	366Q
243C	248A	250F	255D	257B	261C	263C	266B	362B	362I	362P	364B	364I	364P	365A	365H	365O	366D	366K	366R
244A	248B	252A	256A	257C	261D	263D	268A	362C	362J	362Q	364C	364J	364Q	365B	365I	365P	366E	366L	366S
244B	248C	252B	256B	257D	161E	263E	270A	362D	362K	362R	364D	364K	364R	365C	365J	365Q	366F	366M	366T
244C	250A	254A	256C	258A	262A	264A	470B	362E	362L	362S	364E	364L	364S	365D	365K	365R	366G	366N	366U
244D	250B	254B	256D	259A	262B	264B	272A												

. . . Send me these reprints, I will remit on receipt. (See last Reader Service Page for descriptions.)

1 2 3 6 9 11 14 15 17 18 19 20 21 22 22a 22b 24 25 26 27 28 29 30 31 32

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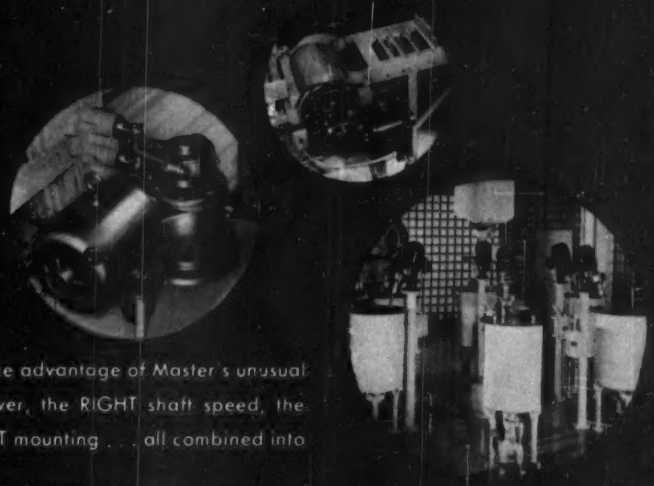
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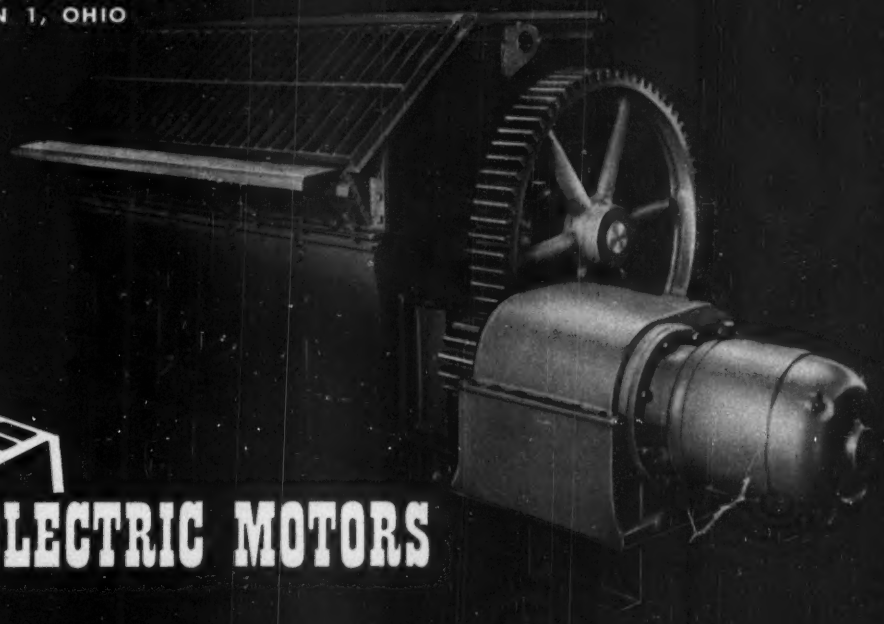
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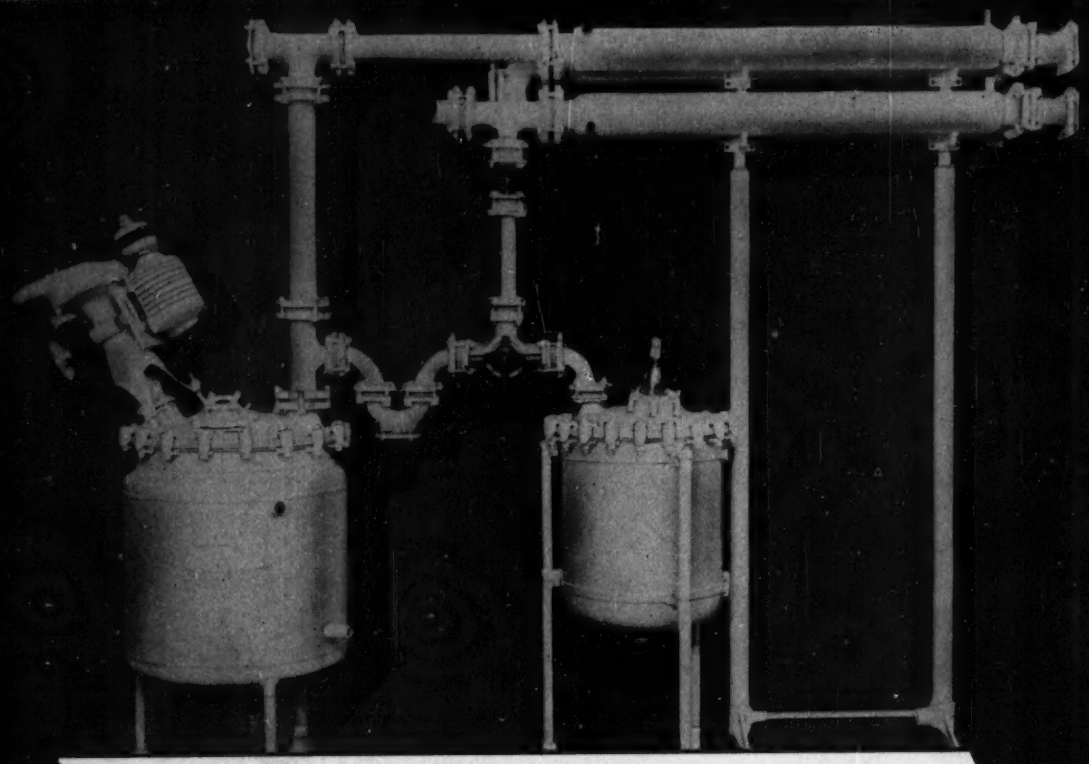
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